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CXXXV. No. 3491 OCTOBER 20, 1944 9d. WEEKLY

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ELECTRICAL REVIEW

October 20, 1944

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Contents :—

	Page
Editorial.—Mass Installation	541
Compression Cable	544
Marine Electrical Work	548
Radio-Frequency Bridges	548
Transformer Operation. By C. H. Pike, Graduate I.E.E.	549
New Books Reviewed	552
Post- War Installations	553
Thermal Insulation	554
Correspondence	555
Institute of Fuel	558
Personal and Social	559

Contents continued :—

	Page
Commerce and Industry	561
Rectifiers for Battery Charging. By F. T. Bennell, Graduate I.E.E.	565
Forthcoming Events	567
Recent Introductions	568
Electricity Supply	569
Financial Section	570
New Patents	575
Contract Information	576
Classified Advertisements	69
Index to Advertisers	78

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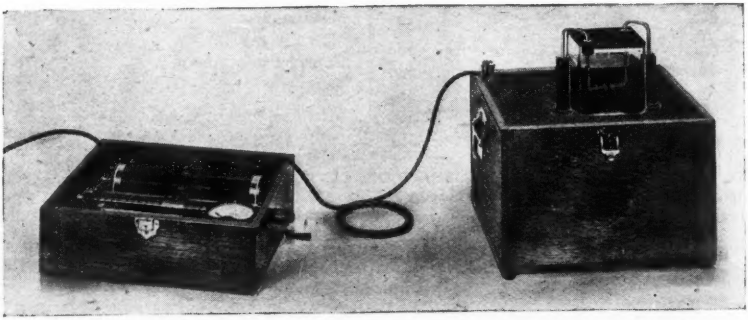

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ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXXV. No. 3491. OCTOBER 20, 1944 9d. WEEKLY

Mass Installation

Electrical Provisions for New Housing Schemes

IN order that the many thousands of small houses and flats which are to be built in the near future may be homes in the fullest sense, the same order of priority will be required for their electrification as is given to their construction. Experience with existing properties indicates that, with appropriately organised productive methods and some modifications in installation technique, the occupants of the new dwellings, despite modest incomes, should be able economically to enjoy all the advantages that arise from the use of electricity for all purposes.

Encouraging Full Use

It will not be enough that the new installations should be carried out on sound engineering lines. They should be designed with the positive aim of encouraging the fullest use of electricity not only for the more ordinary domestic purposes, but also for the convenient working of various essentially electrical small appliances which may be expected to become available in greater numbers as time goes on. These requisites must be in conformity with the need for rapid manufacture at low cost, entailing a high degree of standardisation and the adoption of mass-production methods.

This rare opportunity of starting with a clean slate, but with the benefit of knowledge of what has gone before, has been seized by the Study Committee operating under the ægis of the Institution of Electrical Engineers in making the recommendations for pre-planned installations which are summarised on another page. Of great importance is the plea that provision should be made at the outset for all likely applications of electricity. Other proposals of a basic character are those for the standardisation of a new 60-A consumer's control; of a ring circuit for serving a liberal allowance of general utility sockets throughout the house (which would call for some modification of the I.E.E. Regulations); and of a new 3-kW all-purpose socket outlet with a fuse in the plug.

For meeting the demand for electric cookers which is expected to progress at a rate exceeding even that of the immediately pre-war years, the horizontal kind is advocated. This has proved popular in the Dominions and its manufacture for the home market should therefore possess advantages. That the value of constant hot-water supplies should be recognised goes without saying, but more effort will probably have to be expended in pressing the case for domestic refrigerators; no doubt, as the Committee suggests, present costs of these could be materially reduced through quantity production.

Standard Plugs and Sockets

As some millions of socket outlets will be needed, it is gratifying that the Committee was of one mind regarding a new standard. It was less fortunate in its failure to decide the round *versus* flat pin controversy; the considered opinion of manufacturers on the production aspects, which the Committee awaits, will, it is to be hoped, not be delayed. Finality cannot yet be reached, for causes outside the control of the industry, on the question of whether v.i.r. or p.v.c. insulated cables will

be most readily available. Plastics do not otherwise make an appreciable showing in the Report; nor do all-insulated systems. The foregoing comments apply of course to new houses, and not to all of these. The greater number of buildings already in existence will, no doubt, absorb the output of more conventional production lines until they become obsolescent in the normal course. The present Report presents an imaginative and practical treatment of a subject of great urgency and can be commended to the careful study of those intending to take part in the projected Institution discussion on post-war installations.

An Absolute Essential

RUNNING like a refrain through the Installation Study Committee's Report is a plea for early consultation between the half-dozen interests which (apart from the owner and occupier) may be concerned in the construction of a building, in order to ensure the provision of adequate electrical facilities. It is to be hoped that what might superficially appear to be a Shakespearean "damnable iteration" will be effectual at last. It is an amplified echo of what has been urged so often and, in the first instance, so long ago. Mr. G. O. Watson in his address to the I.E.E. Installations Section (reported on p. 552) quoted a complaint made as far back as 1889 that the electrical installation is "usually the last thing considered by the designer of a ship; consequently the engine and dynamo have to be put in any corner that may be found for them."

Keeping in Touch

NOT the least of the services rendered by the four sections of the I.E.E. are the opportunities that they offer for maintaining contacts among the members, which the war years have generally so sadly interrupted. The range of contacts possible in present circumstances has been greatly extended by the informal luncheons which the sections have organised. Twice as many members and guests (many from overseas) as the 250 or so who could be accommodated had, it was stated, wished to be present at the function of the Installations Section over which Mr. A. G. Ramsey presided last week, indicating that the bonds uniting electrical engineers are not only those due to common technical interests.

Long-Term Cable Test

ONE of the most pleasing features to us of a recent visit to Yorkshire to see the installation which is nearing completion for the long-term testing of a new compression cable for operation at 132 kV (described in this issue) was the opportunity to appreciate first-hand how the Central Electricity Board is co-operating to make the experiment possible. It is extremely difficult or well nigh impossible for cable makers to arrange independently for adequate long-term testing at the highest transmission voltages, and in view of the widely differing schools of thought as to what form a very-high-voltage cable should take it is not too much to say that such healthy co-operation now must have an enormously beneficial effect on the future development of the transmission of electricity.

Quality and Price

THERE has been too great a tendency in the past to consider that British goods will sell in overseas markets because of their superior qualities. Although this belief is firmly based on fact it should not be considered true in all cases and in all places. Sometimes it has been used as an excuse for half-hearted salesmanship and while this has "got away with it" for a time competitors have often stolen a march on British exporters by producing something quite as good as theirs at a better price. There is still a demand for good quality but there is a limit to the extra amount which will be paid for it. But some customers prefer cheapness to quality all the time. In this case it will be necessary to modify ideals if foreign competition is to be countered. Manufacturers are constantly being urged to study their markets; it is quite as important to acquire a thorough knowledge of competitors' products and methods.

Lighting Costs

WHEN the lighting restrictions were eased many local authorities decided that the expense involved in a half-way measure was not worth while. Their people, strongly hoping for an early return to normal lighting, have generally acquiesced—though not always—and in many places the matter is still being discussed. In our opinion the question is entirely one of cost. It is a good thing for the public to have as much light as possible and they should be given it unless the

expense is quite unreasonable, as it often will be, especially where the street-lighting equipment has been badly neglected. Authorities must take into consideration, however, that this equipment will have to be put in order before very long.

Fuel Saving

THERE is, of course, the fuel economy aspect. Last week in the House of Commons, Major Lloyd George said that full lighting would require another million tons of coal a year. At present lighting was on a much more limited scale and he had arranged to find the additional supplies required. (He did not say how or how much.) On the other hand Mr. F. W. Purse in a letter to the *Daily Telegraph* shows that he is totally against partial lighting, considering it a waste of fuel, labour and materials. Although optimism may have been a little damped lately, surely it cannot be long before full lighting will be permissible and once it is the authorities will be unable to withstand the justifiable public demand for speedy restoration. They must be prepared.

Post-war Priorities

FACED with urgent requests for expansion of electricity supplies to rural areas, the Minister of Fuel and Power has intimated that as soon as labour and materials are available after the war priority is to be given to the electrical needs of the bombed areas and of the people who are without homes or have to live in patched up premises. Few will dispute the justice of this decision, but if there is to be a considerable delay in meeting the demands of the country dwellers, those electricity undertakings responsible for catering for them should be exonerated from all blame, for they have already made a substantial start with their plans for rural electrification. If they are not allowed to proceed more opportunities will be given to those who clamour for "reorganisation" as a certain means of securing a supply of electricity for country districts.

Refrigerator Developments

THE introduction of the new "larder-conditioner" referred to elsewhere in this issue raises several interesting points in regard to the future of domestic refrigeration. The new development ensures a really adequate storage space, but will the housewife really think she has a refrigerator if she has no ice-making facilities? The reason the latter are not provided is that the company making it considers it more economical in the circumstances to provide ice-making apparatus as a separate unit if required. Should experience show that the housewife, in the climatic conditions prevalent in this country, is contented to be without ice, why, it might be asked, should not the normal type of refrigerator also be constructed without ice-making facilities for the sake of cheapness? One further question: Is the slightly greater consumption than that of the normal refrigerator important in a working class house? At 2 kWh a day probably not.

South Australian Coal

IN our issue of April 28th we commented on the technical difficulties likely to be experienced by the Adelaide Electric Supply Company in complying with the request of the Government of South Australia that coal mined in the State from the sub-bituminous deposits at Leigh Creek, 380 miles north of Adelaide, should be burned at the company's Osborne power station. Since then analysis has shown coal from an adjacent field to contain only 5 per cent. of ash as against about 16 per cent. in the other deposits, but to have a higher moisture content of 35 to 40 per cent. as mined. Although the quality of this more recently discovered deposit is somewhat better, the cost of dealing with moisture is inevitably high and may consequently neutralise economic improvements due to higher calorific value.

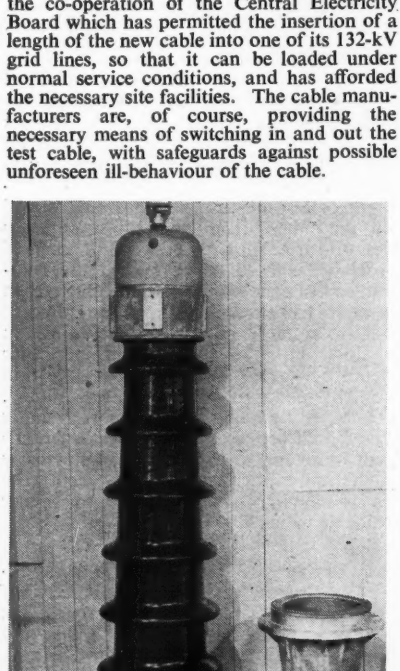
Drying Low-Grade Fuel

THE South Australian Government is now investigating the merits of the Fleissner process, as developed in Canada and the United States (though not, we believe, on any considerable commercial scale), for drying low-grade coal by high-pressure steam in enclosed vessels. By means of this process the moisture content is said to be more than halved and not to be thereafter appreciably increased through exposure to the air. At the moment, however, it is still an open question whether the expense incurred in drying (assuming this to be done at the pit-head) may not be greater than savings in transport of moisture between coalfield and power station.

Compression Cable

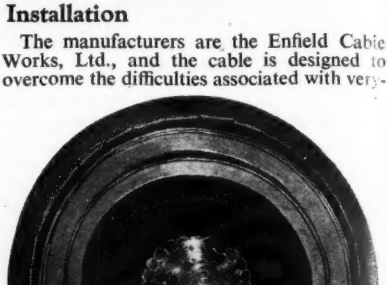
Experimental Installation

A MOST interesting transmission-cable experiment is about to be launched at Osbaldwick, Yorkshire, where an installation is near the point of completion for the long-term testing under service conditions of a new type of cable. This represents part of a great collective effort that is being made by cable manufacturers and experts to find a fully acceptable medium for the underground transmission of electricity at very high voltages, and the experiment is being made possible by the co-operation of the Central Electricity Board which has permitted the insertion of a length of the new cable into one of its 132-kV grid lines, so that it can be loaded under normal service conditions, and has afforded the necessary site facilities. The cable manufacturers are, of course, providing the necessary means of switching in and out the test cable, with safeguards against possible unforeseen ill-behaviour of the cable.



Gas is applied at the base of the sealing-end insulator through a twin chamber casting; complete insulator, oil- and gas-chamber castings shown separately at bottom

The manufacturers are the Enfield Cable Works, Ltd., and the cable is designed to overcome the difficulties associated with very-high-voltage underground transmission consequent on the formation of "voids" in the dielectric systems of cables because of the refusal of the lead sheathing to contract with the conductor and dielectric after they have been expanded as the result of load conditions.



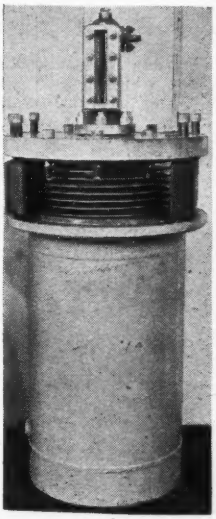
The inner sheath is oval and the outer sheath circular, providing gas spaces between the sheaths to permit breathing

Although the development has been broadly classified as in the field of gas-filled cables, as the gas is not contained within the dielectric system, *i.e.* inside the normal cable sheathing, we feel that gas-filled is hardly the right term. Actually the gas is applied externally to this sheathing which is thereby caused to "breathe" with the contraction and expansion of the conductor by the gas pressure of 200 lb. per sq. in. outside the sheath. This peculiarity puts the new cable proper, *i.e.* the simple formation of conductor, dielectric and inner sheath, constructionally largely in line with the long-standing and accepted "straight" cable associated with lower voltages. The new cable, which is intended to operate at 132 kV and is in consequence of the single-core type on account of easier production and installation, is in principle the same as an earlier three-core development for 66-kV transmission which appears to have been operated successfully, but "secretly," for some years past.

The later development is, of course, intended for three-phase transmission, a line consisting of a cable group trenched in triangular formation with suitable protection. The cable is not limited to any one size, but

in giving the essential details of construction we refer specifically to the Osbaldwick cable which has a current rating of 394 A, representing 90 MVA. The expansion and contraction to which we have referred is facilitated by the slightly oval section of the "breathing" sheath; therefore the cable construction starts with a slightly oval 0·40-sq. in. conductor (61/0·093 in.) which is built up in a normal type of stranding machine. Under the precision control necessary for such very high voltage the core is lapped with layers of paper tape (later suitably impregnated) up to a radial thickness of 0·46 in. Over the paper is lapped a single tape of metallised paper screen and over this is extruded the inner oval lead sheath, or diaphragm which is 0·08 in. thick. The diaphragm is lightly reinforced by two oiled papers and covered with an oiled cotton tape.

An outer circular lead sheath 0·12 in. thick is extruded over the reinforced oval sheath, with the result that there are two "new moon" spaces, one at each side of the oval between the reinforced inner sheath and the outer sheath. These spaces, which really constitute a continuous space of varying depth right round the reinforced inner sheath, are filled with nitrogen gas at 200 lb. per sq. in., so that the outer sheath acts as a gas retainer. The retaining sheath has a double reinforcement, circumferentially and longitudinally.

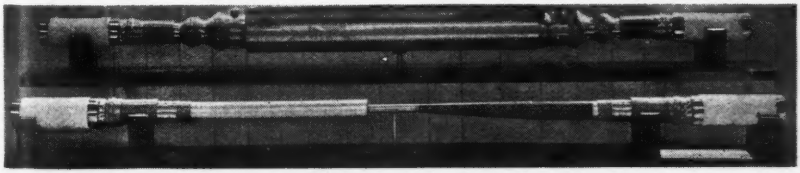


Oil and gas systems are connected to a compensator which balances the oil and gas pressures; compensator shown up-side-down for convenience, inner component raised to show bellows

The circumferential reinforcement consists of two brass tapes which are lapped over two oiled papers and followed by a bedding of bituminised paper to a radial thickness of 0·04 in., and by a compounded tape. The longitudinal reinforcement comprises narrow brass tapes applied overall. Finally there is the makers' overall sandwich cable protection of two layers of non-fibrous insulating material which is reinforced with compounded cotton tapes and, in turn, served with impregnated hessian tapes. This build-up results in an overall diameter of about 3 in.

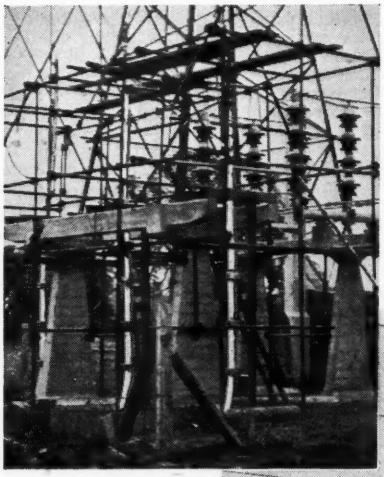
The installation at Osbaldwick is not yet completed, as our photographs show, and the cables, which represent a line length of a few hundred yards round a field, rise out of the ground and up the concrete pedestals of the special switching structure where the cable ends are temporarily "bottled off." The cables will, however, terminate in special sealing-end insulators which constitute an important part of the cable in that the gas is applied to each cable at the base of the sealing-end insulator. This base, which is a casting on which the insulator proper sits, has two chambers hermetically sealed from each other. The inner lead sheathing opens out in the top chamber which is filled with oil at 200 lb. per sq. in., while the outer sheathing opens out into the bottom chamber to which the nitrogen is applied at 200 lb. per sq. in.; thus, through these two chambers the gas and oil systems are fed for the maintenance of stable working conditions, without any interference with, or interplay between, the gas and oil systems.

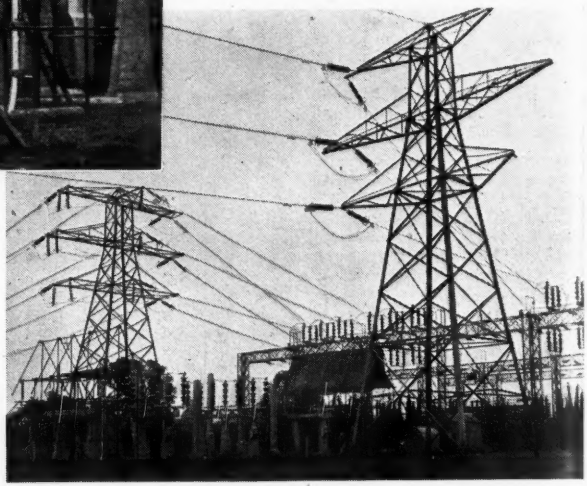
The junction of the two chambers is sealed off externally by means of a "Victaulic" joint consisting of a ring with an inner trough containing a rubber gasket of similar construction, with its channel communicating with the gas chamber. In this way the pressure of the gas forces the rubber against the inner walls of the exterior ring and effects a gas-tight joint. The base of the gas chamber is plumbed to the outer lead sheathing by a normal wiped joint, and by means of a casting, engaging flanges on the gas chamber and the exterior of the cable, the normal wipe is reinforced by an outer bismuth-alloy sealing joint.



The gas path is continued in the joint by the space between the reinforcing tube and the outer casing; joint before insulating (bottom) and with reinforcing tube in position (top)

The gas is supplied to the cable from normal service gas cylinders housed in specially designed gas-reservoir cabinets with suitable anchoring arrangements. The equipment includes an automatic regulating valve, a shut-off valve, a needle valve in the gas line to the cable, and various indicating pressure gauges. The gas-reservoir cabinet is connected by a pipe line directly to the gas chamber at the end of the cable, *i.e.* at the bottom of the sealing-end insulator, but there are connections from the gas line and from the oil chamber at the end of the cable to a compensator which preserves a balance between the oil pressure in the dielectric system of the cable and the gas between the inner and outer sheaths on the bellows principle. The compensator, with the necessary valves and gauges, is mounted on the pedestal carrying the sealing-end chamber.





Above : The cables rise out of the ground and up the concrete pedestals of the special switching structure where the cable ends are bottled off.

Right : Means for switching cable in and out, with safeguards against possible unforeseen trouble

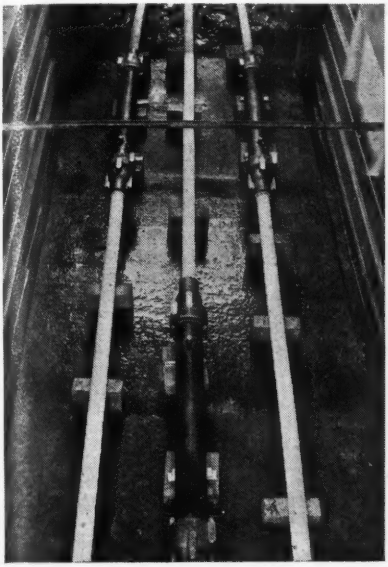
Of outstanding importance is the method of jointing the cable, which can be supplied in 300 to 400-yd. lengths for normal working conditions. In this joint the "breathing" sheath of the cable is represented by a fluted copper sleeve which is placed over the built-up dielectric after the precision hand taping has been applied.

This "breathing" sleeve is plumber-wiped to the lead sheath of the cable through a copper spinning at each end. Over the fluted sleeve is a brass reinforcing tube, and overall there is an outer casing which represents, and is plumb jointed to, the cable outer sheathing *via* a copper spinning. Thus the gas path between the "breathing" and outer sheaths of the cable is represented in the joint by the space between the reinforcing tube of the fluted sleeve and the outer casing. In a similar manner to the arrangement at the sealing-end insulators, the normal wiped joints are reinforced by bismuth-alloy castings in suitable reinforcing moulds. The joint is about 5 ft. long overall, and it is enclosed by a concrete box supported on the concrete floor of the jointing pit and filled with sand.

The 132-kV sealing bells at Osbaldwick embody an entirely new principle, as applied to sealing bells, in dealing with the problem of industrial pollution. The bells were supplied by Taylor Tunnicliff & Co., Ltd., in collaboration with the Enfield Cable Works, Ltd. This principle of "stabilisation" involves the coating of the porcelain with a new type of semi-conducting glaze. Its action may best be explained by considering the mechanism of insulator flash-over due to pollution and moisture.

In an unstabilised insulator a surface current flows from line to earth and, owing to the pollution being non-uniform, the I^2R loss varies from point to point, the greater

dissipation occurring on the higher-resistance parts. This dissipation causes more rapid drying out of the moisture at the high resistance parts than on the lower resistance parts ; consequently the potentials across the higher-resistance parts also increase, and eventually local arcs short-circuit the higher-resistance paths and initiate leakage current surges which sometimes lead to complete flash-over.



Each joint in the compression cable is about 5 ft. long overall

In the stabilised insulator the control of voltage gradient over the surface is taken over by the semi-conducting glaze and local overstressing is avoided. The degree of stabilisation depends on the stabilising resistance ; the lower this is the greater is the stabilisation. In the Osbaldwick sealing ends the stabilising resistance is of the order of 150 megohms between line and earth at 20 deg. C.

Cables trenched in triangular formation about 3 ft. deep with concrete slab protection

Costs of Fuel Saving

METHODS of striking a balance between fuel savings and expenditure of man-power and material required to produce them were discussed in a paper presented by MR. G. N. CRITCHLEY before the Institute of Fuel at Manchester on October 18th. On the initiative of the author, an interim national standard for fuel saving had been taken by which schemes which saved enough coal at £2 per ton to pay for themselves in 2½ years were approved. An improvement on this was suggested in the paper which entailed the design of certain equipment on an incremental rather than an overall basis. The aim was to balance the man-power expended in all stages of manufacturing, installing and maintaining a fuel-saving device against the mining man-power economies it produced.

On the assumption that a saving of 275 tons of coal reduced the mining labour required by one man-year, the time taken (RT_L) for this economy to defray the labour on the device gave a stable relationship. An exploratory relationship between the financial repayment time, RT_F, and RT_L showed the present standard $RT_F = 2{\cdot}5$ yr. to correspond to a labour repayment time of about one year, which was lower than necessary. During the war at least two years for the latter would be justifiable, corresponding to $RT_F = 4{\cdot}5$ yr. As an example of the effect of such a modification, it was shown that the appropriate thickness of heat-insulating brick for roofs of metallurgical furnaces could be increased from 6 to 7½ in. While RT_L was relatively stable, RT_F varied, so the relationship between the two would have to be kept constantly under review. A shortcoming of the financial repayment-time concept was that it gave the same value to all grades of coal. A labour repayment of at least ten years would be appropriate in peacetime. The method could be extended, *e.g.* to balance savings in boiler-house labour against man-power used in manufacture, installation and maintenance.

Marine Electrical Work

Selection and Training of Engineers

THE theme of Mr. G. O. Watson's inaugural address to the I.E.E. Installations Section on October 12th, was the " Future of Electrical Engineering in the Merchant Navy," mainly in regard to the training and education of electrical engineers, which he looked upon as the most pressing aspect. The quality and reliability of electrical installations and apparatus in British ships was, he stated, higher to-day than ever before, as comparative freedom from fires and other troubles showed, but this had been used as an argument against improving the qualifications and responsibilities of electrical superintendents and electricians.

Responsibility for Development

One consequence of this was that the initiative in any new direction was taken by manufacturers, whereas it should come from those whose duty it was to study running results and capital charges in relation to economy if British ships were to maintain their competitive position. For instance, there was a tendency in some countries to adopt AC instead of DC ; the advisability of departing from existing British practice and the problems which were associated with variable-speed drives should be studied in a scientific manner.

There were two problems in training, namely the running and maintenance of installations while at sea and the progressive planning for future development and organisation at headquarters. The two were inseparable because executives were promoted from the lower ranks. Men of the type educated in universities and technical colleges and drawn from manufacturers' works should be encouraged to become sea-going electricians. The present electricians had generally adopted their calling by chance, having been perhaps wiremen or contractors' charge-hands who had remained with the ship but were without encouragement to improve their position by study.

Grades and Qualifications

Two types of men were required. The first should be professional engineers, ranking as officers with a status comparable with that of marine engineers and similarly graded. The junior ranks would be uncertified, but their sea service on electrical work should qualify them for promotion (which it does not now) after examination, coupled with prescribed workshop experience. Suitable qualifications would be the Higher National Certificate in Electrical Engineering or the A.M.I.E.E. examination. Youths should be allowed one free day a week to attend classes, while those at sea might have short intensive courses supplemented by postal tuition.

The second type of electrical man should have passed a suitably modified City and Guilds examination, the course including the I.E.E. Regulations for the Electrical Equipment of Ships instead of those for buildings. This would be combined with apprenticeship to a concern engaged in installation or maintenance of electrical installations of ships. The Institute of Marine Engineers had formulated proposals for the education and training of their members. Similar representations should now be made on behalf of marine electricians.

During the course of his address, Mr. Watson said that the first record of the use of electricity in the Merchant Service (the Royal Navy had adopted it earlier) was in 1879 when the saloon of the Pacific Steam Navigation Co.'s new s.s. *Mendoza* was lighted by means of a Gramme dynamo and arc lamps. In 1883 the Swan United Electric Light Co. recorded the names of twenty-five ocean-going steamers illuminated by incandescent lamps, the largest of which was the Cunarder s.s. *America* with 550 Swan lamps and four dynamos. In 1891 Lloyd's issued rules relating to the use of electric light in vessels, probably the first code for electrical installations ever drawn up.

Radio-Frequency Bridges

BEFORE coming to the more technical aspects of his address on October 11th as chairman of the I.E.E. Radio Section, Mr. H. L. Kirke gave an account of discussions he, together with Dr. Smith-Rose and F. S. Barton, has had with the Institute of Radio Engineers of America, which has led up to the formation of a Liaison Committee. As soon as sufficient paper becomes available, abstracts of the American Institute's papers are to appear in the *I.E.E. Journal* and *vice versa*.

Mr. Kirke then turned to a description of five types of radio-frequency bridge which have been developed and used during the last ten years, namely, a short-wave admittance bridge (1935), a medium- and long-wave admittance bridge, a medium- and long-wave motor-ratio admittance bridge (15 kc to 2 Mc per sec.), an ultra-short-wave high-admittance bridge (100 kc to 100 Mc per sec.), a medium- and long-wave series (low) impedance bridge (100 kc to 2 Mc per sec.), and in addition a low-frequency capacitance bridge—the forerunner of some of the radio-frequency bridges. He concluded by giving some particulars of associated apparatus, including an oscillator designed to cover the frequency range from 150 kc to 28 Mc per sec. in six bands with provision for battery operation and a straight-tuned radio-frequency receiver with a beat oscillator and audio-frequency selectivity.

Transformer Operation

Effect of Loading on Life Expectancy

By C. H. Pike,
Graduate I.E.E.

MORE economic operation of transformers may be achieved by more effective use of capacity as loads increase and by reducing running charges. The advantage of adopting the first course is, primarily, that capital expenditure can be postponed if desired and that new units will embody any technical improvements in the interim. Such improvements may in themselves lower running charges, which with existing units may be reduced by closer attention to such factors as energy losses and maintenance expenditure.

More effective utilisation implies increasing the load on individual transformers to an extent which does not shorten the physical life unduly. The economic life of a transformer is usually reckoned more or less arbitrarily for accounting purposes at from twenty to thirty years, at the end of which period all the fixed charges will have been met and the depreciation allocations made will permit the replacement of the unit. The physical life may be considerably longer and whatever margin remains is subject only to running charges.

The existence of a margin of physical life indicates incomplete utilisation during the economic life. Financial policy may require under-utilisation with an economic life period less than the actual life-expectancy. Moreover, loading below rated capacity may minimise the total energy loss and maintenance charges. Nevertheless, more effective utilisation of existing capacity may result in greater economic efficiency. The several factors which must be taken into account require each case to be considered individually.

Rate of Deterioration

The permissible loading of a transformer depends largely on the life expectancy required. Normally a transformer will continue to give satisfactory service until the mechanical strength of the insulation deteriorates to such an extent that it cannot safely withstand the stresses likely to arise in service. Rate of deterioration is determined largely by the heating to which the insulation is subjected and increases with temperature.

In Table 1 above insulation life values estimated by V. M. Montsinger[1] are shown. These probably give a reasonably accurate indication of the useful life, since the insulation as a whole may retain adequate strength after complete deterioration at the hotspots.[2] The values may in fact be conservative, since no attempt was made to keep the ambient oil perfectly dry; hence the insulation itself probably contained moisture. Now in 1942 F. M. Clark showed[3] that the rate of mechanical deterioration of insulation increased with moisture content, especially at higher temperatures. In recent years the effect of developed acidity on mechanical strength has also been demonstrated.[4, 5, 6] As in the Montsinger research these effects were not eliminated—no attempt being made to keep the oil dry or acid-free (though the quantities present were probably small)—the life values stated might reasonably be considered as applicable to insulation used in practice.

Temperature and Life

The starting point of a utilisation investigation is the life expectancy required. Assuming this is thirty-five years, the continuous maximum or hot-spot insulation temperature permissible is 80 deg. C. Hence a transformer can be loaded so as to produce a hot-spot temperature of 80 deg. C. continuously (the daily life consumption being 0·0078 per cent.). With variations of ambient temperature and load a representative daily load cycle must be obtained. The percentage of life used up can be computed by summating the percentage consumption at the various temperatures prevailing for known periods. From the Montsinger data in Table 1 the percentage life consumption can be calculated for different temperatures and the daily total found.

As an approximate example, with a transformer operating on a daily load cycle made up of four periods of six hours at 80, 70, 60 and 50 deg. C., about 0·0056 per cent. of its life would be used up daily. Thus there is a margin for increased loading to an extent which might, for instance, produce temperatures of 90, 80, 70 and 60 deg. C. equivalent to a daily life consumption of 0·0076 per cent.

Unless a winding temperature indicator

TABLE 1.—LIFE OF OIL-IMMERSED INSULATION

Temperature, deg. C.	40	50	60	65	70	75	80	85	90	95	100	105
Years	82	70	58	52	46	40	35	30	23	16	10.5	7.0

is fitted, hot-spot temperatures must be estimated from the correspondence between hottest-oil temperature and load over a daily cycle, which entails a knowledge of the full-load gradient between hot spot and hottest oil together with its variation with load. In general, the gradient of an ON transformer at any load is given by $L^{1.5}G$, where L is the actual load expressed as a multiple of rated full load and G is the full-load gradient. The calculated gradient added to the corresponding oil temperature gives the hot-spot temperature.

Calculation Based on Weekly Figures

Where the number of distribution transformers is large, calculation of temperature is impracticable for checking the daily rate of ageing at sufficiently frequent intervals to ensure that changes in seasonal conditions (ambient-air temperature, maximum load and load factor) do not produce excessive temperatures. Nevertheless, although the data may be inadequate to permit utilisation of all unused capacity, some increased loadings will generally be practicable. For instance, if values of maximum hottest-oil temperatures and load are available weekly, together with approximate load factors, increasing loads can be checked by applying elementary principles.

Consider, for example, a transformer operating with a load factor of 50 per cent., and a peak load equal to rated capacity. Assuming that the loading is such as causes maximum daily loss and heating, *i.e.*, the transformer is fully loaded for twelve hours and is off load but excited for the other twelve hours, with constant ambient temperature, the daily life percentage for a given expectancy will be consumed at two different rates. During the no-load period the percentage is determined by the corresponding temperature—approximately that of the hottest-oil. The no-load temperature or a light-load temperature is usually obtainable.

At 50 deg. C. with 0·00196 per cent. of the life consumption in each no-load period, for a life of thirty-five years, the permissible daily percentage is 0·0078, so that there is a balance of 0·00548 per cent. available for use in each twelve-hour full-load period, the equivalent daily percentage being 0·01168. By simple calculation the temperature permissible continuously during the full-load period is approximately 90 deg. C. This value is the limiting temperature for all transformers operating at or below the specified load factor and no-load temperature.

In practice, if the permissible temperature is not being attained, the load on each unit can be allowed to grow, or can be transferred, until such time as it is reached and, perhaps, occasionally exceeded. In the latter circumstance the effect on life should be negligible as there is likely to be an appreciable margin to allow for contingencies because the load is spread over the day and the maximum temperature exists for only a part of the time. The hot-spot temperature, the essential quantity required, is obtained by the sum of the hottest-oil temperature and $L^{1.5}G$.

Provided the reference temperature is not exceeded consistently and the load factor remains at 50 per cent. the peak-load value is unimportant, though considerations other than thermal capacity may set a limit to this. A substantial increase in load factor may necessitate a new reference temperature. For instance, an increase from 50 to 70 per cent. implies that the peak load is carried for seven-tenths of the day and no load for the remainder. In this case the life consumption in the no-load period is 0·001176 per cent. leaving a balance of 0·006624 per cent. for the full-load period. The equivalent daily percentage is 0·00947, which will be consumed with a continuous temperature of approximately 85 deg. C. Again, the actual value of the peak is not important provided the hottest-oil temperature plus $L^{1.5}G$ does not exceed 85 deg. C.

The temperature value employed for the calculation of the no-load life consumption may be, for convenience, the highest probable during a particular period and considered constant, but in practice it will vary with ambient temperature. If an indication of maximum ambient temperature is available, more effective utilisation of transformer capacity will be practicable by adjusting the no-load temperature values to accord with any wide seasonal and local differences in ambient temperatures. In some locations, the lower ambient temperatures during certain periods should permit higher hot-spot limiting temperatures and, therefore, greater peak loads—for a given load factor.

Overload Charts

Overloading of transformers when ambient temperatures are below the standard reference values is permitted by B.S.S. 171. If the ambient temperature indication satisfies the requirements of the Specification it can be used, together with load factor, to establish permissible loadings. B.S.S. 171 does not, however, include sufficient data to cover the range of operating conditions usually encountered, but the American Standards Association has compiled charts for this purpose.[7, 8] These charts are based on factors investigated by V. M. Montsinger[9] and others.

In general, for self-cooled transformers, 1 per cent. increase of rated capacity is allowed for each 1 deg. C. that the ambient air temperature is below 30 deg. C., and an additional 3 per cent. increase is allowed for each 10 per cent. that the daily load factor

is below 100 per cent. By applying these allowances effective utilisation can be achieved by reference to ambient temperature indications which, for a given load factor and transformer thermal characteristics, will determine the permissible peak loads (as percentages of rated capacity). For this purpose Table 2 should be used. This refers particularly to self-cooled transformers conforming to United States standards, but it should also apply to most British ON units.

Given the hot-spot rise above ambient at rated capacity and the life-expectancy required, the column containing the 100 per cent. value must correspond with that ambient-temperature value which, added to the hot-spot rise, gives the continuous temperature permissible to achieve the required life-expectancy. Table 2 refers to any ON transformer operating under conditions which will permit the required life-expectancy to be realised provided the appropriate hot-spot temperature obtains when full load is carried continuously, the ambient temperature being 30 deg. C. For example, for a life-expectancy of thirty years the hot-spot temperature for continuous operation is 85 deg. C. so that if this is the appropriate value for Table 2 the transformer concerned has a hot-spot rise above ambient (30 deg. C.) of 55 deg. C. at rated capacity.

To adjust the table to particular requirements, given the continuous hot-spot temperature appropriate to the required life-expectancy, the difference between this hot-spot temperature and the full-load hot-spot rise is the ambient temperature value corresponding to the column containing the 100 per cent. load datum. For example, in a table applicable to a 60 deg. rise transformer with a life-expectancy of thirty years, since the continuous hot-spot temperature permissible is 85 deg., the 100 per cent. load datum will correspond to a 25 deg. ambient.

Thus continuous full load is permitted only when the ambient temperature does not exceed 25 deg. C. This means, in effect, that the peak loads permissible with a 55 deg. rise transformer in a 30 deg. ambient are allowed with a 60 deg. rise unit in a 25 deg. ambient. In the latter case, the peak loads permissible with any combination of ambient temperature and load factor are 5 per cent. less than those shown in Table 2; *e.g.*, at 100 per cent. load factor, 30 deg. C. ambient the permissible peak is 95 per cent. of rated capacity and *pro rata* with other values.

With load factors less than 100 per cent. the hot-spot temperature will, of course, exceed the value permissible continuously due to overload peaks, but the daily ageing of the insulation will not be greater than when the basic temperature is maintained continuously — it may, in fact, be less. In practice, once a table has been compiled for a particular type of transformer, the actual hot-spot temperatures are not required. A periodical observation of peak load and maximum ambient temperature—with an occasional check on load factor—will indicate adherence to the tabulated conditions relevant to the required life-expectancy. Since the ambient temperature is likely to be below the maximum for periods, an adequate margin for contingencies is assured.

TABLE 2.—PERMISSIBLE PEAK LOADS OF SELF-COOLED TRANSFORMERS (PERCENTAGE OF RATED CAPACITY)

Per cent. load factor	Ambient Temperature Deg. C.								
	0	5	10	15	20	25	30	35	40
50	145	140	135	130	125	120	115	110	105
60	142	137	132	127	122	117	112	107	102
70	139	134	129	124	119	114	109	104	99
80	136	131	126	121	116	111	106	101	96
90	133	128	123	118	113	108	103	98	93
100	130	125	120	115	110	105	**100**	95	90

With moderate overloads, probably the only disadvantage is an increased rate of oil deterioration. In addition to this, with heavy overloads consideration may have to be given to the effect on oil expansion, load capacity of bushings, leads and soldered joints and associated equipment, such as tap-changing gear, voltage regulators and circuit-breakers. Overloading may increase running charges due to more maintenance and higher energy loss due to operation at lower efficiency. Short-time overloads may result in an increased all-day efficiency due to fewer units being required. Poor regulation due to overloading may cause a loss of revenue and reduced efficiency of the apparatus supplied.

The extent of the greater utilisation permissible will depend on the past history of the unit concerned and the manufacturer's opinion regarding the durability of the insulation. The life of the transformer will depend ultimately on what percentage of the original mechanical strength of the insulation can be lost with safety. Unfortunately this cannot yet be stated accurately, but if precise information were available, transformer capacity utilisation could be effected scientifically. Recent investigations show that, while the first 50 per cent. of the mechanical life of cellulose insulation is lost at a comparatively rapid rate at the higher temperatures, thereafter the rate diminishes quickly. F. M. Clark showed[3]

(*Continued at foot of next page*)

NEW BOOKS REVIEWED

Plastics—Radio—Wiring

Plastics for Production. By Paul I. Smith. (180 pp.; illus.) Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 12s. 6d.

Mr. Smith has started his book well, with an excellent well-balanced preface explaining what he endeavours to achieve. There is an interesting discussion of the possibilities for employment offered by plastics. It is noticeable that he has not included electrical engineering among the large potential employment channels in relation to plastics. It almost certainly is one of the chief employers of plastics technicians at present. His good intentions are to some extent thwarted by the intensive condensation. The book is far too small to allow for the satisfactory handling of such an enormous subject.

Mr. Smith has considered plastics from the functional point of view. He does not bestow unqualified praise on the materials, being careful to point out their limitations. He does not suggest that they will answer every problem. He has tried to assess objectively their performance in various conditions. In his first chapter he analyses the qualities involved in the selection of a plastic for a particular purpose.

He summarises the range of plastics very succinctly and rather too briefly. Naturally his consideration of the use of plastics for insulation was of the greatest interest to the reviewer. The electrical industry is one of the greatest outlets for plastics of every description. It is very difficult to do justice to such an enormous subject in the small space which Mr. Smith could devote. The same applies to his sections on wire covering, the deposition of metals on plastics materials and the effects of temperature on plastics.

But in spite of its defects the book is a very useful addition to the plastics library. It is written for the practical technical man, steering clear of the scientific implications. It is full of the salient facts relating to plastics, brought together in a convenient form.—H.B.

Thermionic Valve Circuits. By Emrys Williams, Ph.D., B.Eng., A.M.I.E.E. Second edition. (Pp. 208; figs. 127.) Sir Isaac Pitman & Sons, Ltd., 39, Parker Street, London, W.C.2. Price 12s. 6d.

The appearance of this second edition so soon after the first (published in 1942) is explained by the author as "having been hastened by the extensive consumption of the first edition by the enemy Luftwaffe." A good deal of new material has, however, been added including an original general theorem on valve oscillators and sections on frequency modulation, gas-filled valves, time-bases, the Kipp relay, the transitron, the cathode follower, earthing and screening, and valve voltmeters.

Although open to the criticism of incompleteness, the author does not attempt the impossible and try to include all valve circuits, but contents himself with covering the main types of circuits in such a way that the student should be in a position to understand, or even foresee, further developments.

First Course for Electricians. By T. C. Gilbert, A.M.I.E.E. (Pp. 62; figs. 36.) Morgan, Laird & Co., Ltd., 54, Bloomsbury Street, Bedford Square, W.C.1. Price 3s. 6d.

In so few pages it is surprising how much information the author has been able to impart. This he has done in such a lucid fashion that the reader can absorb it with the minimum of effort and is put in the right frame of mind for continuing investigations on the subject. Originally appearing in the form of twelve articles, the book is intended particularly for men and women taking up electrical work in the contracting business, factories and the Forces. After a preliminary simple explanation of current, voltage, resistance and power, it passes on to series and parallel connections, cables, methods of wiring, safety precautions, fusing, earthing, switching and lighting, and bell circuits. Special attention has been paid to wartime practice and substitutes. Details are also given of the leading electrical associations.

Electric Wiring. By W. S. Ibbetson, B.Sc., A.M.I.E.E., M.I.Mar.E. Eighth edition. (Pp. 264; figs. 136.) E. & F. N. Spon, Ltd., 57, Haymarket, London, S.W.1. Price 10s.

In this new edition, the third issued during the war, various additions and alterations have been made to bring the matter into conformity with certain recent B.S.S. and the 1943 alterations and additions to the eleventh edition of the I.E.E. Regulations. This has been done without altering the original numbering of the pages, an achievement of particular importance in view of the widespread use of the book for educational purposes.—W.R.C.

Economic Transformer Operation

(*Continued from preceding page*)

that the tensile strength of manila paper in a sealed container under oil in contact with oxygen fell from 18×10^3 to 8×10^3 lb. in fifty weeks at 100 deg. C. and then appeared to diminish at a very slow rate.

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Post-War Installations

Study Committee's Report

THE report of the Committee set up under the ægis of the Institution of Electrical Engineers (with Mr. J. R. Beard as its chairman) has been issued by the Ministry of Works as No. 11 in its series of Post-War Building Studies. (Stationery Office, 1s. 6d. net.) The terms of reference covered a review of existing practice concerning installations in buildings, including household appliances and telecommunications, and the making of recommendations for post-war practice. Different sections of the Report of 96 pages deal with houses and flats (with particular attention to the smaller type), multi-occupier buildings (including ownership and control of service cables), schools, hospitals and farm buildings. There is a useful bibliography, four new terms for the Standard Glossary and an eight-page index.

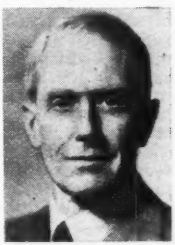
The first and longest section of the Report deals with small houses. Service arrangements, it is urged, should provide at the outset for the full use of electricity for all purposes. For underground services, the recommended standard is 0·0225 sq. in. twin paper-insulated lead-sheathed unarmoured cabled, made to BS 480–1942, and laid at not less than 18 in. below gardens and 12 in. below paths. Overhead services should be of the same cross-section, single or twin, rubber (or p.v.c.) insulated, taped, braided and weather-resisting. Under-eave construction is suitable for semi-detached or terrace houses and wayleave procedure should be amended where necessary to permit of its adoption.

Earthing Methods

Internal installations should be earthed to the water main, to the sheath of the service cable, to electrodes (subject to periodic inspections) or, where these methods are impracticable, through an earth-leakage circuit-breaker or multiple earthing. A provisional standard consumer's control unit for incorporating any existing designs of cable sealing box, main switch, four single-pole fuseways and meter is described ; it measures 34 in. high by 13½ in. wide by 7½ in. deep, but the development of a more compact unit is urged. In the meantime the type of fitting which serves as cable sealing and main supply fuse box should be used. Existing designs of consumer's control equipment should be housed in a box with a door for building into a wall.

In small dwellings lighting fittings should be supplied complete with lamps. Wiring or conduit should be run to the cooker position in each kitchen. For water heating, a new multiple 20-gal. unit is advocated. Refrigerators should be of 4 cu. ft. capacity. Early consideration should be given to the thermal insulation of buildings. Recesses for electric fires and convectors should be provided during building and there should be accommodation in the kitchen for washboiler, washing machine and drying cupboard.

Socket-outlets should be installed, as a minimum, as follows : Living rooms, 3 ; double bedrooms, 3 ; single bedrooms, 2 ; kitchen, 3, in addition to connections for cooker and refrigerator ; water heater, 1 ; laundering, as required. Lighting switches should be 4 ft. 6 in. above floor level. Socket outlets should be not less than 5 in. but preferably 9 in. above floor level, except in kitchens and washhouses where the height should be 4 ft. 6 in.



Mr. J. R. Beard

Three circuits should be provided : for lighting, for cooking and for socket outlets. The last should be supplied from a ring circuit fused for 30 A at the consumer's supply control or, alternatively, a circuit fused for 15 A could be run to each principal room. Enclosed cartridge fuses (Category 3, B.S.88) should supersede rewirable porcelain fuses.

A new flush- or semi-recessed type of 3-kW socket outlet and easily withdrawable fused plug should be adopted as the "all purpose" domestic standard with the live contacts of the socket protected ; incorrect insertion of one pin of the plug into the live contact tube of the socket, thus exposing a live pin of the plug, should be made impossible. On AC circuits a separate switch is considered unnecessary. Socket terminals should accommodate a 7/·029 in. cable looped in and out and also a spur connection if required ; solid pins should not be slotted. The plug should accommodate either a 13-A or a 3-A interchangeable and readily identified fuse and should take either 23/·0076 or 70/·0076 circular flexible cords.

For wiring, v.i.r. or p.v.c. cable run in screwed or lug-grip jointed light-gauge welded or brazed-steel conduit or else a continuous wall duct at skirting level is recommended. Central heating, if adopted, should furnish background heat only, small radiant electric fires being used to give higher local temperatures.

For larger houses, a consumer's control unit with eight fuse ways or two separate units (one containing the undertaking's cable

entry and main fuse and the other centrally mounted fuses) are proposed. The use of quick-acting circuit-breakers instead of a main switch and possibly instead of circuit fuses should be considered.

In multi-occupied buildings the undertaking should own, control and maintain the service cables, which it would provide at its own cost; retailing by the landlord of supply purchased in bulk is to be discouraged. A three-phase four-wire AC service would be taken from the 400–230-V mains or from a transformer installed in the building. Rising mains should be run in accessible ducts (not lift shafts) at least 18 in. by 6 in., one duct to supply each floor or, in larger buildings, one duct measuring 36 in. by 9 in. perhaps for each 5,000 ft. of ground floor area; bare conductors are recommended. Horizontal mains may be run in floor ducts or hollow ceilings in corridors. For flats, a vertical duct should enter a sealed distribution board on every storey, provided with single-pole fuses for each service, conduits being run to the consumer's control.

Farm Requirements

While installations in urban buildings possess many major features in common, there are many special features in farm buildings to be taken into account. In order to reduce power wiring costs appliances would generally be grouped together. Power requirements on a dairy farm would be: Milking machine, ½ to 1 HP; steriliser, 4 to 9 kW for 20 to 40 cows; water heater, 1 to 3 kW; cooler, ¾ to 2 HP; water-pump, ½ to 1 HP. In addition there may be: Hoist, ½ to 1 HP; mixing machine, 5 HP; grinding mill (new type), 3 HP; cake breaker, 2 HP. For mixed farming, the following would also be needed: Chaff and root cutting and cake breaking, 10 HP; threshing, sawing and crop drying, 10 to 20 HP. On poultry farms from ¼ to 1 W will be required per egg incubated, 1½ to 2 W per chick reared and 2 or 3 W per laying bird for light and warming water.

Electrical accessories would preferably be of the insulated type and more robust than is usual for domestic purposes. For wiring a general purpose t.r.s. cable, protected with cotton braid, vulcanised and compounded over and containing an earth conductor, is recommended. A high degree of mechanical protection is needed in a limited number of situations only, when insulating conduit may be used. Metal conduit is not recommended since for safety it would require to be separately earthed and, unless galvanised, would be liable to corrosion. In damp or corrosive conditions p.v.c. cable may be more suitable than t.r.s. cable.

Wiring should be installed well out of normal reach. In dairies cleat wiring may be used, as it can be cleaned by hosing down, with mechanical protection for down-drops to sockets and for leads to motor terminals. Appliance frames should invariably be earthed. The service line (usually overhead) would preferably terminate at the centre of the heavier loads. For supplying near-by outbuildings, t.r.s. or p.v.c. cable may be slung from a catenary. For more distant loads a light open line should be used.

Thermal Insulation

AN analysis of the properties and processes which control the flow of heat in continuous and intermittent heating operations was given by Dr. H. R. FEHLING in a paper he presented before the Institute of Fuel on October 4th. Every heat insulating material, he said, had two components, one solid and the other gaseous. Low thermal conductivity was due to the air or gas enclosed in pores and voids. This was not accounted for only by the conductivity of air being about one-tenth of that of the poorest solid conductor; an essential factor was the bottleneck produced by its being the highest resistance in a series.

A most important characteristic was the relative proportions of air and solids in the structure of a material. There was a broad relationship between the conductivity and bulk density of widely differing materials; for insulators, variations from the average did not exceed ± 30 per cent. On the other hand heat capacity per unit volume, which was roughly 1,000 times greater for solids than for gases, was determined by the solid components and was proportional to bulk density, the deviation from the average being small.

The author suggested that the marked difference in variation with bulk density between conductivity and capacity had hitherto been overlooked, though it was important in regard to intermittent heat flow. The diffusivity, or the ratio of conductivity and capacity, had a minimum value for a bulk density of 0·7 to 0·9 (about 50 lb. per cu. ft.). An insulating layer not only upset temperature gradients throughout the wall but also the thermal resistance at the surfaces. The possibility of reducing radiation losses by using surfaces of low emissivity was limited because the increase in surface temperature increased convection loss. In steam transmission there was a secondary power loss in the engine, due to deterioration in steam quality, which could be of the same order as the heat loss.

With intermittent operation, heat capacity and duration of the heating cycle were equally important. For heating from cold, heat storage was the dominant factor and hot-face insulation the only means of preventing wall losses. For re-heating operations storage and surface losses might be balanced in certain cases. Heat stored in insulating bricks was only a fraction of that absorbed by ordinary refractory walls in the same time—the reduction being more than that owing to reduction in weight because the product of conductivity and capacity was the controlling factor. Insulating bricks in the hot face shortened heating-up time, lessening storage loss.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Domestic Plugs and Sockets

I WAS interested in Mr. James Scott's letter in your issue of October 6th and heartily endorse his view that every plug circuit, regardless of purpose, should be wired with at least 7/·029 cable. The City of Edinburgh Electricity Department has recently made a similar recommendation to electrical contractors as follows :—

> "*In domestic premises*, in view of the possibility of the introduction of, and to facilitate changing over later to, a new standard universal 13-A 3-pin socket outlet and plug to cover the functions of the existing three sizes of standard socket and plug, it is recommended that nothing less than 7/·029 in. (·0045 sq. in.) conductors be used for wiring to sockets no matter which size of socket may be installed initially. In the case of a room not exceeding 200 sq. ft. in area we propose that there should be no limit to the number of sockets (possibly in addition to a fixed electric fire) *in the one room* which may be connected to one final sub-circuit of this size. For rooms larger than 200 sq. ft. 7/·036 in. (·007 sq. in.) conductors (or 7/·029 in. conductors ringed, *i.e.*, fed at both ends) should be used if one fixed fire and one socket or more than one socket is connected to a single sub-circuit. Furthermore, all the sockets and fixed fires in a *maximum of four rooms* with an aggregate floor area of not more than 600 sq. ft. may be connected to a single sub-circuit provided that 7/·036 in. conductors are used (or 7/·029 in. conductors ringed). These recommendations are to be regarded as additional exemptions under Clauses 201B and 202D but Clauses 202A and 116A shall still apply, which means that not more than 15-A fuses shall be fitted on 7/·029 in. sub-circuits and 30-A fuses on 7/·036 in. (or 7/·029 in. ringed on one fuse only) sub-circuits and that flexible cables with smaller than 70/·0076 in. (·003 sq. in.) conductors must be fitted with fused plugs."

This recommendation goes even further than Mr. Scott's suggestions. The clause numbers refer to the I.E.E. Wiring Rules.

Edinburgh. P. d'E. STOWELL.

THE difficulty of inserting three pins into three socket holes was mentioned by Mr. A. N. Bott in your issue of September 1st. This is true of the more usual brown socket but it is much easier to do so in the case of a white or cream socket, in which the three socket holes are more readily visible. If it is considered essential that sockets should match the skirting-board, shutter-type sockets having shutters of contrasting colour could be used.

A further improvement would be the provision of a rectangular finger grip on the plug cover, in the position occupied by the knob of the handshield type. When picked up by this grip between the thumb and forefinger the plug would be automatically rotated into the correct position for insertion in the socket. The grip would also be of assistance in withdrawing the plug and the additional space inside it could be utilised for a more efficient cord-grip than is usually provided.

The foregoing suggestions apply equally to all three-pin plugs and sockets, but I am convinced that the existing B.S. types will meet all post-war requirements. While the "tree" system may still be preferred for large houses, commercial, and industrial installations, a "fused room" scheme similar to that suggested by Mr. Newton Davey in the same issue would be adequate in the smaller houses at minimum cost. A self-contained unit could be produced incorporating one 15-A three-pin switch-socket, two 5-A three-pin shuttered sockets, and a cartridge fuse. One of these units would be installed in each room and would feed four or five additional 5-A three-pin shuttered sockets by means of a ring main passing right round the room.

The scheme would make for greater safety by limiting the use of electric fires to one position in the room while providing full flexibility for other portable appliances.

Southampton. B. J. FRANCIS.

IN the recent controversy about ring mains and plugs and sockets for dwelling houses the majority of the suggestions seem to have emanated from advocates of cheap installations. The introduction of ring mains and one size of plug and socket would result in all kinds of abuses. The handyman or amateur electrician could not resist the temptation to tap the ring main in any old way and while the use of fused plugs in certain circumstances is quite good, that arrangement would certainly not be satisfactory if it was decided to use one size of plug only. In all probability no spare cartridges of the correct size would be available and the handyman would simply stick in anything available.

One correspondent suggests that nothing less than a 15-A plug should be used and then strangely enough he goes on to condemn chain stores and such places who sell a lot of electrical junk. Certain "installers" would never dream of connecting, say, two 5-HP motors to one pair of fuses but have no hesitation in connecting two or three 8/12-A radiators to one circuit.

Twenty years ago we had plugs of all sizes and shapes which could only be regarded as a nuisance until the British standards were adopted and as these standards have justified themselves, why not leave well alone? In these remarks I do not intend to deal with

rules and regulations but feel that all radiators of 8/12 A should be connected to separate circuits on a distribution fuse-board and wherever possible I adopt that method.

So far as 5-A outlets are concerned, these should only be regarded as lighting or possibly iron points and therefore half a dozen of them can be connected to one circuit with safety. The 2-A outlet cannot be ignored; it is a very useful accessory for radio or bell circuits and, when the correct size of plugs are fitted on the ends of flexibles, it is impossible to plug "the wrong thing in the wrong place." Both 5-A and 15-A outlets should be fitted with interlocked switches and, although some of these have proved unsatisfactory, there are good ones on the market.

I hope the present arrangement of standards will remain and if someone can suggest a method of cheapening installation costs without sacrificing efficiency and safety, I shall support it. I am, however, definitely against ring mains and one size of plug for dwelling houses.

Glasgow. ALEX. MILNE.

An Industrial Aspect

IN regard to standardisation of plugs and sockets one very important industrial application has not received much attention, and it may well be that in the future the same problem will arise with domestic apparatus, *i.e.*, the use of plugs and sockets for low-voltage portable apparatus.

In a large steel works there may be two supplies, *viz.*, three-phase 400-V four-wire AC and 220-V, two-wire DC. In such a works there will be a number of portable tools, handlamps, soldering irons and the like, the majority of the universal type. It is most desirable that all portable tools should operate at either 25 or 50 V single-phase. Where there is an extensive distribution system an endeavour should be made to eliminate all 230-V and 220-V plugs and sockets. The risk of plugging in 25- or 50-V apparatus on to single-phase, 230-V or DC 220-V circuits will thus be removed. This course is sometimes very difficult and in certain cases impossible, and with such a mixed system it becomes essential to have available two- or three-pin 25-V or 50-V plugs and sockets which are quite non-standard, even perhaps to have square pins on the plugs and square holes in the sockets. It is quite inadequate to have two-pin or three-pin plugs with pins of the standard sizes but different centres for the two sets of voltage conditions.

The time has arrived when the question of plugs and sockets for low-voltage industrial as well as domestic portable apparatus should be given careful consideration, and regulations issued to ensure complete safety.

Sheffield. R. BENNETT,
Chief Electrical Engineer,
Thos. Firth & John Brown, Ltd.

Phase Indicator

THE correspondence columns of your issue of September 22nd, contain a reference to a phase indicator. This is a very useful instrument, but it has its limitations in phasing out an AC system for the purpose of paralleling. It will indicate the phases of a supply to give a clockwise or anti-clockwise rotation for a motor, regardless of colours, letters or numbers marked on cables.

There are no doubt instances of jointers connecting up the wrong colours and it is possible for a number of combinations of colours, etc., to give the same rotation. A voltmeter can be used to indicate the correct phases for paralleling, regardless of colours, letters or numbers on the cables and at the same time indicate whether the pressures are correct.

T. R. EVANS,
Rhondda. *Electrical Engineer.*

Post-War Houses

WITH reference to the Ministry of Works' sample houses erected at Northolt, I have only the information provided in your issue of October 6th, and from the photograph there it would appear a compromise structure in more ways than one.

The view of the front which you illustrate appears to have an abnormal window space for the size of the house. While this may be very pleasant with a southern aspect in the southern counties, they would certainly be chilly rooms in the North of England with a northern or easterly aspect. We have heard a great deal on the scientific design of houses with regard to the use of fuel, but it would appear that in these particular houses this has been sacrificed to cheap construction.

It would be interesting to have the views of the heating engineer who may have had access to the plans of the Ministry's houses; or has the Ministry other designs which take care of this point?

Ruislip. R. N. PEGG.

Permanent Magnets

MAY I thank Messrs. Hoselitz and Edwards for their criticism of my letter which they gave in your issue of October 6th. It has given information which all will be glad to have. Admitting that my idea was wrong, it is still true that the experiment suggested would have led to useful results and it would have shown that there was benefit in magnetising the metal while it was undergoing heat treatment.

Cases are common where the idea behind an experiment is wrong but the results have been good. The Michelson-Morley experiment, to find the speed with which the earth moved through the ether, was a failure but it led to the relativity theory. Faraday tried the effect of placing a magnet in a coil, which he

then connected to a galvanometer without result, as S.P. Thompson has related, but it led eventually to something worth while. As a student the late Dr. Thornton tried an experiment which failed and he told Lodge that it was absurd, but Lodge replied "An experiment is never absurd."

I think it was Clerk Maxwell who encouraged experiments because, he said, if the student did not find what he was looking for he might find something else. My letter may encourage some student to make experiments on his own from which he will learn something worth knowing. I heard from a chemist who had worked with Perkin that Perkin said that he discovered his aniline dyes by doing an experiment which seemed to be absurd but that also was worth while.

Tynemouth. C. TURNBULL.

Freedom of Choice

MR. D. MURPHY, in his letter in your issue of October 13th, is not using the correct arguments for what he advocates. The general view of an engineer is that the resources of the country, in this case the energy in coal, should be used with the utmost efficiency so that there will be a sufficiency of exportable margin to pay for future imports. The cost and comfort to the user are of secondary importance, and can be adjusted to conform with the social policy of minimising the number of miners required to obtain the desired amount of coal.

The first deduction is that soft coal in the domestic hearth should be entirely abolished. This is conducive to reduction of costs in decorations and cleaning, diminution of the pollution in the atmosphere and a marked reduction in the cost of building construction because of the elimination of chimneys ; also the ventilation can be more accurately designed and the absurd situation of heating air *after* it leaves a room completely eliminated.

Electric power, being very easily transmitted over great distances, demands also that the coal be efficiently used in the power station boilers. This means that the surplus heat which is available, because of the use of turbines, must be diverted and supplied to local factories and domestic premises. Experience abroad shows that this can be done economically and it is being seriously considered by Coventry, Bristol and Luton in this country.

An interim proposal before the traditional fireplaces are removed from use is that coke be substituted as a hard fuel. This immediately necessitates a supply of gas for its ignition. It can be shown that if a quantity of coke is required there is a minimum quantity of gas to be disposed of economically. A very large increase in the demand for coke can be made economical only if the consequent increases of gas are disposed of economically. The actual usage of gas is increasing very slowly, whereas electrical energy is being taken year by year at a rapidly increasing rate. It therefore follows that the electrical industry has nothing to lose in agreeing to a more logical use of products of coal than is advocated at the moment. The one way in which the surplus gas should be used is in water heating and central heating in domestic premises. The use of electricity for such "low-grade" utilisation should be deprecated.

The question of regulation also arises, in that the superior regulation of electricity supply makes it more suitable for those high-grade applications in which a constant voltage is essential, whereas the lower grade of regulation which is economically possible with gas makes the use of gas suitable only in such applications as can be thermostatically controlled.

Engineers should not hesitate to use their knowledge in advocating wider issues rather than in supporting sectional interests which they may individually be considered entitled to support.

London, N.W.8. L. E. C. HUGHES.

[CORRECTION.—In Mr. D. H. S. Sanderson's letter in our last issue the word "latter" in the fifth line should have been "former," *i.e.*, it is washboilers with immersion heaters which have to have sumps. This was obvious from the subsequent wording.—*Editors, Electrical Review.*]

Bonding and Earthing

IN a lecture illustrated by lantern slides which he delivered to the Coventry Electric Club on October 3rd, Mr. P. W. CAVE dealt with bonding and earthing systems in relation to the generation or use of electricity and to protection against damage by lightning.

Among the types of earthing electrode described was the recently introduced sectional earth rod for deep driving. The effect of site conditions on the choice of a particular type of electrode was discussed and the methods of carrying out the necessary electrical survey before designing and installing an electrode system were described. Examples from practice given included the time taken to drive earth rods into soil of widely differing character to depths varying from 8 to 40 ft.

Advice was given as to the correct layout of bonding systems and formulæ were developed for the current carrying capacity of bonds under fault conditions of short duration.

E.A.W. London Branch

THE autumn programme of the London Branch of the Electrical Association for Women will be opened next Tuesday, by a talk by Miss Caroline Haslett, director of the E.A.W., on her second visit to Canada and the United States. The White Paper on Social Insurance, "Wool and the British Empire," and the Tennessee Valley Authority will form the topics for later meetings.

Institute of Fuel

Proceedings at Annual Function

THE principal guest at the annual luncheon of the Institute of Fuel, at the Connaught Rooms, London, W.C.2, on October 12th, was LORD WOOLTON, C.H., Minister of Reconstruction, who proposed the toast of the Institute. Lord Woolton said that Great Britain was never more in need of enlightenment in fuel utilisation than at the present day. There was a time when coal was cheap and plentiful and the griminess of our cities testified to the wasteful way in which we had used our greatest raw material. Nobody then dreamed that we should be so short of coal as we were to-day.

In wartime our people were willing to endure much from the various Ministries which controlled their lives but in the matter of coal we should not be any better off in peacetime unless we bestirred ourselves. Industry would have to continue to operate at as great a rate after the war; would it be able to get all the coal which it would need? Then there was the export trade; we should need to export much more if we were to be able to purchase what we needed from foreign countries.

Economic reconstruction plans depended for their success upon a healthy, competent industry; and industry and the economic future depended largely upon the efficient use of fuel, which meant research. We needed cheap coal but we also wanted cheaper means of using coal. Cheap coal did not mean lower wages for the miners but the scientific mining of coal combining maximum output with high wages.

The Ministry of Fuel and Power was investigating this matter and looking into the organisation of the gas and electricity industries. Its Fuel Efficiency Committee was doing invaluable work in making industry "fuel conscious." All these efforts should produce results: the matter was one of great urgency. In the past we had been slow to make use of the knowledge of our scientists and this would have to be remedied.

In his response the president, DR. E. W. SMITH, C.B.E., spoke of the great days of Manchester University when he and Lord Woolton were fellow students there. He mentioned that Lord Woolton was to be Chancellor of the University and referred to the many eminent fuel technologists which Manchester had produced.

LT.-COL. W. A. BRISTOW, in proposing the health of the guests, said that the development of power achieved during the war would have been considered impossible in 1935. The policy of the Institute had always been to co-operate with all branches of the light, heat and power industry without political or sectional bias. He referred especially to the presence, among many other distinguished guests, of representatives of the Ministry of Fuel and Power and of Mr. Harold Hobson, chairman of the C.E.B.

In seconding the toast, MR. P. C. POPE (secretary) said that before the end of the year the membership of the Institute would have reached 2,000. Industrial organisations had been asked to subscribe to a five-year guarantee fund. The Institution came between the research organisations and industry. The speaker asked if there were not an appropriate Government Department to give assistance to the Institute similar to that given to research associations and thus enable it to make a more substantial contribution to the fuel economy campaign. The toast was replied to by MR. R. W. FOOT, chairman of the Mining Association of Great Britain.

Presidential Address

After the luncheon Dr. Smith delivered his presidential address. In the course of this he spoke of three recent developments within the Institute. They were the reorganisation of the seven sections and their representation on the Council; the raising of the standard of candidates for admission; and the establishment of a £5,000 guarantee fund, half of which had already been promised. He went on to say that there had been very real and almost revolutionary advances in the technical side of the gas industry and reviewed these at length.

Melchett Lecture

This year's Melchett Medallist is Dr. J. G. King whose Melchett Lecture followed Dr. Smith's address. The title of the lecture was "The Pattern of Fuel Research" and it surveyed developments in this field, mainly during the past twenty-five years. Much attention was devoted to the hydrogenation of coal and coal products and the speaker then passed to advances in the gasification of coal for the production of town gas and to the considerations governing further research on coal structure and properties.

Spanish Supply Restrictions

MADRID will be without electricity in the daytime for three days a week. The restriction is due to persistent drought in Spain which has considerably reduced power production. So that the cut shall not affect the entire population at the same time the city has been divided into areas in which the supply will be cut off on three different days. Towns and villages in the Madrid province will also be affected.—*Reuter*.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE staff of Barnstaple Corporation Electricity Department have presented an inscribed clock to **Mr. F. C. Allen** who has retired from the post of chief assistant engineer after being connected with the undertaking since 1902. Mr. Allen went to Barnstaple when the Corporation electricity undertaking was established, and before that was on the staff of the Lynton and Lynmouth undertaking.

Mr. Ernest Stroud, who has been elected president of the Illuminating Engineering Society for 1944-45, has for many years been chief engineer of Holophane, Ltd., and for the last five years general sales manager. He has served on various committees of the British Standards Institution, including street lighting, portable photometers, light distribution, lighting fittings, and A.R.P. street and factory lighting. He is an associate member of the Association of Public Lighting Engineers, and chairman of the Street Lighting Section of the Electric Light Fittings Association. He acted as treasurer of the I.E.S. from 1936 to 1938.

Mr. Ernest Stroud

The **Hon. J. K. Weir** has been appointed managing director of G. & J. Weir, Ltd. **Mr. A. H. Laidlaw** becomes director in charge of sales and contracts, while **Mr. John Davidson** has been appointed secretary in place of **Mr. J. D. Imrie,** who has resigned that office for health reasons after forty-five years' service. Mr. Imrie's services are being retained.

Hull Corporation Committee has presented a long-service certificate to **Mr. D. Bellamy,** the general manager, on the completion of twenty-five years' service.

The *A.E.I. News* announces the election to the board of the Cosmos Manufacturing Co., Ltd., of **Messrs. A. S. Kettle, J. W. Ridgeway** and **E. Y. Robinson.**

Mr. Kettle has been manager of the Cosmos company's works since 1941. He served his apprenticeship with the Bournemough & Poole Electricity Supply Co., Ltd., in its Bourne Valley and Christchurch power stations and in 1911 joined the British Thomson-Houston Co., Ltd., with whom he took a two-year testers' course. Afterwards he was for two years in charge of the DC testing section and was then appointed chief of the department responsible for the testing of all products made at the Rugby works. In 1928 he was appointed service engineer to the B.T.H. company, in which capacity he held a watching brief on the board's behalf in any complaints in respect of products, and he carried out special investigations on behalf of the directors.

Mr. Ridgeway, after a metallurgical training, joined Metro-Vick Supplies in 1924, and was attached to the radio department at Sheffield. In 1928 he was appointed assistant to the then chief engineer of Metropolitan-Vickers radio department and in 1929, on the amalgamation of the radio divisions of the B.T.H. Co., Metropolitan-Vickers and Edison Swan, he was appointed assistant manager of the radio division of Edison Swan and he became manager in 1940. He has been chairman of the British Radio Valve Manufacturers' Association for the past three years. Recently he was appointed industrial adviser on radio valves to the Radio Production Executive of the Ministry of Aircraft Production.

Mr. Robinson joined the research department of Metropolitan-Vickers Electrical Co., Ltd., in 1922, to establish a valve section having previously been a college apprentice at the Trafford Park works. For some time he worked on the development of large power valves, but later his interests were mainly directed to radio receiving valves. Arising out of this work a radio valve production department was established in 1925. In 1927 this manufacture and development were transferred to the Cosmos Manufacturing Co., with Mr. Robinson as chief engineer of the valve department. He was appointed chief engineer of the company in 1929, when its activities were directed solely to radio valves.

Engineer Vice-Admiral Sir George Preece, K.C.B., has accepted nomination by the Council of the Institute of Marine Engineers for re-election as president for the 1945-46 session.

Mr. J. W. Rodger, M.I.E.E., director and general manager of Bruce Peebles & Co., Ltd., has been appointed managing director of the company. Mr. Rodger who was formerly the company's chief engineer became general manager at the beginning of last year. He joined Bruce Peebles in 1924 for the purpose of inaugurating and developing the production of power transformers. He built up the new department in an extensive factory and later, as chief engineer, became responsible for all the company's design and manufacturing departments. He has travelled much in Europe and Canada to study practice and requirements. Before joining Bruce Peebles he had been with several leading electrical manufacturers including Ferranti, Ltd., and the Hackbridge Electric Construction Co., Ltd.

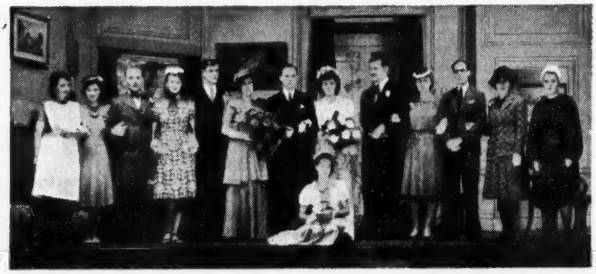
Mr. J. W. Rodger

Mr. R. M. S. Morrison has been appointed sales manager of Scottish Plastics, Ltd.

The two Brush Scholarships for 1944 have been awarded to Messrs. **Derek Davis** (Staveley Grammar School) and **John T. Hayden** (City of London School). These scholarships are of the value of £75 per annum, tenable for four years, the first year in the works at Loughborough and the remaining three at any British university. After taking their degree, scholar-

ship holders return to Loughborough for a final year of apprenticeship.

The Metrovick Dramatic Society run by the staff of the Metropolitan-Vickers Electrical Co. has become so active as to require a set of studios.



Final scene in " Quiet Wedding " presented by the Metrovick Dramatic Society

In spite of wartime difficulties it has recently presented Esther McCracken's comedy " Quiet Wedding " at four evening and one matinee performances and achieved notable success.

Mr. C. E. Luxton, manager of the electric tool division of the Consolidated Pneumatic Tool Co., Ltd., has been granted indefinite leave of absence in order that he may take up an appointment as Technical Adviser on Portable Electric Tools to the Director of Industrial Electrical Equipment, Machine Tool Control.

Mr. C. W. Allbut has been appointed to succeed the late Mr. A. R. Edwards as commercial manager and secretary of the Electric Lamp Manufacturers' Association in Australia. He has for many years been associated with the Australian General Electric Pty., Ltd.

Mr. G. H. Oldroyd, borough electrical engineer, Stockport, who was due to retire on November 25th, has been reappointed for a further period of six months at his present salary.

Mr. Julius A. Krug has been appointed acting chairman of the United States War Production Board in the place of Mr. Charles E. Wilson who, as previously reported, has decided to return to the General Electric Co. of which he was president before joining the W.P.B.

Paisley Association of Electrical Engineers opened its new session on October 9th when **Mr. Thomas Scott** delivered his presidential address which dealt with " Modern Factory Installations."

The Association of Supervising Electrical Engineers is inviting applications for the post of organising secretary at a commencing salary of £500 per annum.

Obituary

2nd Lieut. J. M. Dalton.—We extend our sympathy to Sir John Dalton, manager and secretary of the County of London Electric Supply Co., Ltd., and Regional Controller for London and the South-East District, Ministry of Fuel and Power, and to Lady Dalton for the loss of their only son, 2nd Lieut. John Michael Dalton, R.E., Parachute Regiment, aged twenty, who died as the result of an accident on October 7th.

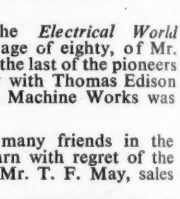
Mr. E. W. Robey.—We regret to record the death of Mr. E. W. Robey, who was for many years on the staff of the Underfeed Stoker Co., Ltd., and subsequently of International Combustion, Ltd. Mr. Robey was responsible for the introduction and development of many new appliances connected with the combustion and boiler-making industries.

Mr. A. A. Cawkwell, who was also for some years associated with International Combustion, Ltd., died recently. He retired in 1936, after a lifetime spent in the boiler-making field. In his earlier years he was with the Stirling Boiler Co., Ltd., which he left to join the Niclausse Boiler Co., Ltd.

Mr. James Smith, former assistant superintendent of telegraphs, G.P.O., Edinburgh, has died at the age of eighty-one. For many years he taught telegraphy and telephony at the Heriot-Watt College.

Mr. H. E. Tanis.—The *Electrical World* reports the death, at the age of eighty, of Mr. Hulbert E. Tanis who was the last of the pioneers who went to Schenectady with Thomas Edison in 1886 when the Edison Machine Works was moved from New York.

Mr. T. F. May.—His many friends in the electrical industry will learn with regret of the death on October 1st of Mr. T. F. May, sales manager of the Leyton works of the London Electric Wire Co., and Smiths, Ltd. Mr. May who would have been 53 this month, was educated at All Souls, Langham Place, and after a brief period with the St. James' and Pall Mall Electricity Co., Ltd., joined the Sun Electrical Co., Ltd., which he left in 1914 to take up an appointment with W. T. Henley's Telegraph Works Co., Ltd. In April, 1927, he joined the London Electric Wire Co. and Smiths, Ltd., as assistant sales manager and in 1929 was appointed to the position he held at his death. Mr. May leaves a widow and one son who is serving with the R.A.F. in Italy. The funeral took place at Golders Green Crematorium, among those present being Mr. G. E. Jewell representing Mr. W. J. Terry (chairman and managing director of the London Electric Wire Co. and Smiths, Ltd.), Mr. S. B. Klein (assistant general manager of the Leyton works), Mr. Ernest Leete (director), and many representatives of other electrical companies.



The late Mr. T. F. May

COMMERCE and INDUSTRY

Factory Accommodation. Compact Service Units.

Disposal of Government Factories

INDUSTRIALISTS who will later require space of 10,000 sq. ft. or more in surplus Government factories or storage premises, which they are willing to use for peacetime industrial purposes, are invited to apply to the Registrar, Control of Factory and Storage Premises, Neville House, Page Street, London, S.W.1. Except in special circumstances, factories will not be sold outright but will be let for a period of ten years, at the end of which there will be an option for a further lease for a long term. The short lease will commence from the date when the Government is able to release the factory from war work, unless the selected tenant is the present occupier, in which event the short lease can commence at once.

The factories will be allocated in accordance with certain criteria of national interest, such as the establishment of a balanced distribution of industry ; the re-establishment and expansion of the export trade; the maintenance of a war potential ; the requirements of town and country planning ; the ability of individual applicants for factories to make efficient use of the factory premises with the minimum of reconstruction ; and the claim, on grounds of equity, of firms whose factories have been damaged or destroyed by enemy action, or have been requisitioned by the State under concentration schemes or otherwise.

A.S.E.E. Branch Merit Competition

The examiners have now announced their decision on the first year's competition between branches of the Association of Supervising Electrical Engineers for the best all-round record for the period 1943-4. In their report, they speak highly of the interest and value of the educational and business activities of the winning branch, and of its development on a carefully constructed plan. A silver cup will be presented to representatives of Birmingham Branch at the opening meeting of the 1944-45 session on October 21st, at the Lighting Service Bureau, London.

Domestic Training for Service Girls

To those thousands of women stationed at gun sites and similar establishments the present state of activities has brought a good deal of increased leisure; many of these young women on returning to civil life will be setting up home for the first time. Therefore, some training in domestic subjects given at the present time would be of real assistance to them when they are demobilised.

At Luton, the Electricity Department has offered to use its organisation to give instruction in cookery, etc., to young women from local Service establishments and experimental classes have already been formed and tuition started. It was felt that small classes, with consequent individual attention, would be most suitable, so, as a beginning, two classes of eight girls each have been formed and each class will attend six sessions of about two hours' duration at weekly intervals.

A cooking class for Service women in progress at the Luton Electricity Department's showrooms

Each session includes a period of instruction in the use and care of the cooker, followed by tuition in the basic principles of cookery and recipes, after which the girls themselves carry out some preparation and cooking. This last practical work occupies a good proportion of the time. It is proposed to use the final session for a general chat on the domestic use of electricity for water heating, laundry and so on. The girls are keen, intelligent and really anxious to learn. The accompanying photograph is reproduced by courtesy of the *Luton News*.

Hundred Years of Ironmaking

An attractively produced illustrated brochure, issued in connection with the recent commemoration of a century of ironmaking, tells the story of the Midland Iron Co., Ltd., of Rotherham, which commenced forging in 1844. The wrought iron trade reached its heyday in 1855–65 when the concern was converted into a limited company. Further expansion raised the quantity of iron manufactured to 12,000 tons in 1880, occasionally amounting to 1,600 tons per month, at which time the whole of the plant was steam driven. Modernisation took place in 1904, when the old 16-inch beam engine was dismantled and the rolling of steel commenced, although the main product of the works remained wrought iron.

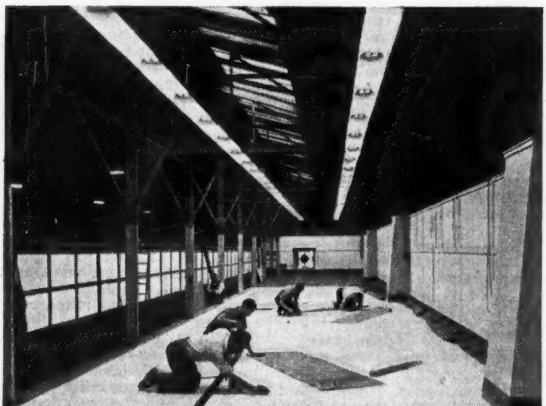
A start was made with electrification in 1928 when the rolling mills were converted, but trading became difficult subsequent to the 1926 coal strike which rendered the works idle for some months. After reconstruction in 1930, Thos. W. Ward, Ltd., of Sheffield, took control and introduced such improvements as an overhead electric gantry for the stock yard, a 5-ton overhead crane with a 46-in. diameter lifting magnet for loading material and a 500-HP motor for driving the forge train, which with various auxiliary installations completed the electrification of the plant.

Lighting for Layout Reproduction

Fluorescent tubes are proving most effective for the lighting of layout reproduction rooms. Layout reproduction, a process largely developed in America, has in the past year been used with conspicuous success by the aircraft industry in this country. By its use full-scale drawings of aircraft components are made on metal sheets which are subsequently photographed, the originals serving as "masters" and the prints as working drawings. In some cases metal sheet with a sensitized surface is used; this is exposed and developed and is used in the manufacturing process, thereby obviating "marking-off."

The rooms generally are composed of a staging raised about 3 ft. 6 in. from floor level and made up of a series of tables 8 ft. by 4 ft. If required, these can be used independently or joined together to form one huge table. The one illustrated is about 160 ft. by 20 ft. wide. The draughtsmen move about on top of this table when making drawings and wear special sandals or slippers made of thick felt.

The illumination must be uniform over the whole area and as shadowless as possible, the lighting intensity must be high and the fittings mounted sufficiently high to allow free movement of the draughtsmen and, since the work is carried out on metal sheets, a low brightness light source is imperative even though the sheets are treated to minimise the specular reflection. There is no other light source that fulfils these requirements so well as the fluorescent tube, the low temperature of which is another advantage when one considers the high-intensity illumination (35-40 ft.-candles) that must be provided. In the room illustrated this intensity is provided by two rows of continuous troughing spaced at 8 ft. centres with "Osram" fluorescent tubes in twin tube circuits mounted 10 ft. from the table area.



"Osram" fluorescent tubes used for lighting a layout reproduction room

Lamp Publicity

Thorn Electrical Industries, Ltd., are offering retailers a window display service for "Atlas" lamps, in spite of the continued shortage of labour and materials. A photograph of this season's standard window display, built up with cartons and poster, is reproduced herewith. This is one of several attractive sales aids which the company is supplying to retailers and, in addition, increased national and provincial Press advertising is being carried out.

"Atlas" lamp window display

Restoring Dnieper Plant

It is reported by *Reuter* that nine hydro-electric turbo-generators for the Dnieper plant in the Soviet Union are to be manufactured in the United States. They are to replace those destroyed by the Russians when they retreated before the Germans in 1941. Their manufacture and installation will require at least four years for completion. This machinery will not be provided through lend-lease but will be financed by the Soviet Government.

E.I.B.A. Donations

A number of handsome donations, ranging from £50 to £250, were sent to the Electrical Industries Benevolent Association in the period from May to August. The list sent

us by the secretary includes the names of well-known people in the industry, several of the leading manufacturing companies and no fewer than eight more electricity supply undertakings—company and municipal.

In a message to the electrical industry, Mr. J. N. Stephens, the new president, says it is hoped that the next twelve months will be a period of great excitement and good news and will therefore present more than ordinary possibilities and more than ordinary dangers. The E.I.B.A. Council asks that at this time of good omen, and later when present high hopes are realised, all should mark their relief and gratitude by assisting both with money and work, to an even greater extent than before, the E.I.B.A., which is an example of that social decency for which the war is being fought.

Facts About the Railways

So far 2,387 miles of railway in Great Britain have been electrified at a cost of over £50,000,000. In a normal year main line electric trains run over 51 million miles. This information is given under one of the 48 alphabetical headings in an interesting booklet just issued by the British Railways and London Transport. In addition, there is a list of outstanding events from 1825 to 1943, and a section on railway finance and statistics.

Northampton Electrical Association

The annual general meeting of the Northampton and District Electrical Association was held at the Northampton College of Technology on October 11th. Mr. O. F. Bailey, Principal of the College, was in the chair and was re-elected for the ensuing year. Mr. W. P. Barnell, one of the prime movers in the formation of the Association, who acted as secretary for the first year, resigned owing to pressure of business, and a vote of thanks was passed to him for the services rendered. After the election of officers and and other business, two sound films of topical interest were shown. Anyone who is engaged in any branch of the electrical industry and is interested in the Association can obtain details from the College of Technology, St. George's Avenue.

Production Control

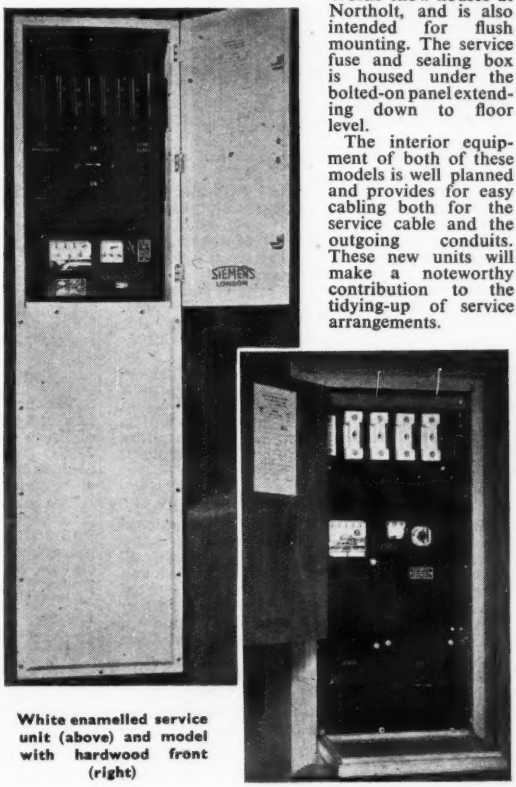
The second of three booklets dealing with production control (B.S.1100, Pt. 2, 1944, price 2s. post free) published by the British Standards Institution, 28, Victoria Street, London, S.W.1, gives advice on production control technique in the small factory, with the over-riding object of stressing the need for control if production is to be economically increased and waste of time and effort eliminated. The booklet may be found of greatest use in the factory employing 50 to 200 people, but it is recognised that for production control purposes a factory employing 200 people may be simpler than one employing 50 if the type of product in the former is less complex than in the latter.

The text of the booklet is illustrated with specimen schedules, cards, record sheets and a comprehensive order flow chart which shows the various stages through which an order will pass.

House Service Units

A combined house service unit produced by Siemens Electric Lamps & Supplies, Ltd., for post-war houses was described in our issue of May 19th last. The company has now produced models of two further types, shown in the accompanying illustrations. The one with a hardwood front is to the design of Mr. R. Plummer, A.M.I.E.E., and is specially dimensioned to suit standard brickwork, an important point to be considered when mounting the unit flush into the wall. The white enamelled unit is one of two manufactured for the Ministry of Works show houses at Northolt, and is also intended for flush mounting. The service fuse and sealing box is housed under the bolted-on panel extending down to floor level.

The interior equipment of both of these models is well planned and provides for easy cabling both for the service cable and the outgoing conduits. These new units will make a noteworthy contribution to the tidying-up of service arrangements.



White enamelled service unit (above) and model with hardwood front (right)

Mechanised Farming

The need for greater mechanisation of farming after the war was emphasised by Mr. Tom Williams, M.P., Joint Parliamentary Secretary to the Ministry of Agriculture, at an agricultural and horticultural machinery demonstration arranged by the Surrey County War Agricultiral Executive Committee at Eashing Farm, Godalming, last week. Since 1939, he said, British farmers had spent £100 million on farming machinery and equipment and two-thirds of it had been supplied by manufacturers in this country.

Farmers watching a demonstration of welding at Godalming

When the war had ended, Great Britain, which had disposed of practically all its overseas investments, would more than ever need to utilise machinery to maintain and expand home production. British machinery makers would, besides supplying the requirements of this country, be in a good position to meet the needs of farmers on the Continent.

Apparatus displayed included dairy equipment, pumping plant, sheep shearers and various equipment concerned with the cultivation and harvesting of potatoes and other root crops. Particular interest was shown in a demonstration of welding as applied to the repair of agricultural machinery.

New Westinghouse Publication

The Westinghouse Electric International Company announces the publication of a new technical magazine for Latin America, *El Ingeniero Westinghouse*. Printed in Spanish and issued bi-monthly, it contains articles from recent issues of *Westinghouse Engineer*, together with additional engineering information of special interest to technical readers in Latin America.

Philips Lamp Publicity

Philips lamp advertising this season will develop still further the theme of the lamp as a transformer of electricity into light. The method of presentation, however, has been changed. In place of the humorous sketches, scraper-board drawings are being used, and the advertisements are intended to have more of a prestige appeal. For example, one illustration shows a 45,000-ton battleship travelling at speed, with a large lamp superimposed, the copy explaining that the Philips lamp is a transformer of electricity into light, no less efficient in its way than the turbines of a battleship, which transform steam into the power which gives the battleship its speed. Other illustrations are of a submarine, Spitfire aeroplane and the "Coronation" locomotive, the copy theme being similar in each case.

These advertisements will appear in the London evening and a large number of provincial daily and evening newspapers, as well as in two of the national Sunday papers. Two national periodicals have again been included, and a new departure is the inclusion of two women's journals. The trade, technical and industrial journals will again be well represented, and the campaign will open in these with a bold and simple prestige announcement. The now famous "Flag" poster ("See it Through with Philips Lamps") will again be well in evidence in the London Underground, in the form of lift and escalator cards, and 20 in. by 30 in., 60 in. by 40 in. and 16-sheet posters.

Two window display pieces will be available this year. One is a two-sided display card, 18 in. by 12 in., suitable either for window or counter use, which has been reproduced by a paint transfer process on to pressed board made from scrap leather. The other is a larger display which again is two-sided, and has been reproduced by offset on to linen. Measuring 45 in. by 34 in. this will provide a most striking and effective centre-piece for a complete window display. A new general lamp catalogue will cover all lamps still being supplied, giving revised prices and details of purchase tax.

South African Brush Subsidiary

The Brush Electrical Engineering Co., Ltd., has set up a subsidiary company under the title of Brush (South Africa) (Pty.), Ltd., (P.O. Box 7995), 20, Bitcon Road, Johannesburg. This company will initially build buses and coaches and certain electrical equipment in South Africa and will handle the sale of the following products of the Brush Company in the Union :— Turbo-alternators, transformers, switchgear, motors, generators, traction equipment, Diesel-electric locomotives and battery vehicles and trucks. It will also superintend the distribution of Petter oil, paraffin and petrol engines in the Union.

Changes of Address

The *Passenger Transport Journal*, has returned to its pre-war address at Avenue Chambers, Vernon Place, Southampton Row, London, W.C.1 (telephone: Holborn 9914).

The Chorlmet Radio Electric, Ltd., is moving next Monday to 64–66, Shudehill, Manchester, 4 (telephone: Blackfriars 1054).

Rectifiers for Battery Charging

Calculation of AC Voltage from Required Output

By F. T. Bennell,
Graduate I.E.E.

THE somewhat difficult mathematical problem presented in arriving at the voltage that must be applied to a battery-charging rectifier in order to obtain a certain charging rate is usually solved by means of a graph. For ease and accuracy, however, reference to a form of trigonometrical table is to be preferred, the problem being thus resolved finally into trigonometrical ratios.

In addition to providing a solution on these lines, this article also attempts to reduce the problem and its solution to their simplest forms and to make them applicable to rectifiers with any number of phases. As much calculation as possible is carried out in the preparation of the tables referred to, leaving a minimum of work to be done in the application to particular cases.

In practice, a simple empirical formula may be used for the majority of cases, any inaccuracies being covered by the adjustable resistances or transformer tapping switches usually incorporated in battery charging equipments.

An exact means of calculation is, nevertheless, required for the following purposes: As a guide when developing an approximate empirical rule; for determining the limits of output between which that rule will give best results for average cases (the accuracy becoming progressively less as those limits are approached); for border-line cases where the ability of a particular size of rectifier element to deal with the required output is in doubt; and when standard designs are being developed for the purposes of bulk production.

Only the basic calculation is here dealt with and no account is taken of the voltage drop in the rectifier element, the slight reverse current or the distortion of wave-form caused by the inductance of the transformer. Allowances must be made separately for such of these factors as will appreciably affect the result.

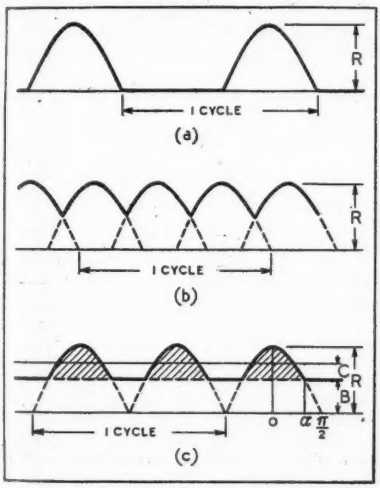


Fig. 1.—Output voltage wave-forms (a) from each rectifier phase; (b) from three-phase rectifier (p = 3); (c) from single-phase full-wave rectifier (p=2) when connected to battery (Case 1)

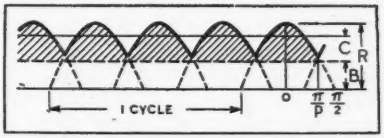


Fig. 2.—Output voltage wave-form from three-phase rectifier when connected to battery and the minimum rectifier voltage is higher than the battery voltage (Case 2)

Sometimes, when there are three or more rectifier phases, the output voltage is unaffected by the battery. A different method of calculation must then be employed and, for the sake of completeness, this case is also dealt with.

In designing a rectifier, the battery voltage and charging current being specified, the charging voltage (*i.e.* the average excess of the rectifier output voltage over the battery voltage) is calculated from the charging current and the resistance of the charging circuit. The voltage wave-form from each rectifier phase consists of half a sine wave as shown in Fig. 1 (*a*), the other half being obstructed by the rectifier, and the rectifier output voltage is the maximum voltage obtaining in any of the phases, Fig. 1 (*b*). Finally, when the rectifier is connected to a battery the output voltage is the maximum voltage obtaining in either the rectifier or the battery, Fig. 1 (*c*).

Two distinct cases arise which will call for different treatment. Case 1 is when the output voltage is affected by the battery voltage, *i.e.* when the minimum value of the rectifier voltage is lower than the battery voltage, as in Fig. 1 (*c*). Case 2 is when the output voltage is not affected by the battery voltage, as shown in Fig. 2.

Case 1 includes all single-phase and most three-phase battery-charging rectifiers. In

this instance, when the rectifier voltage is below the battery voltage the battery tends to feed back, but is prevented from so doing by the one-way character of the rectifier. It is only during the periods—shown shaded in Fig. 1 (*c*)—when the rectifier voltage exceeds the battery voltage that a charging current flows.

The average charging voltage corresponds to the average height of the shaded portions. An expression for this voltage can therefore be obtained by dividing the sum of the shaded areas by the total distance along the time axis, or more specifically the amount of shaded area per cycle by 2π radians.

The charging periods occur once per cycle for each rectifier phase; the wave-form of each period is symmetrical. For simplicity, therefore, the areas in only a half of one

TABLE 1

P	No. of Rectifier Phases	1	2	3	4	6
K_1	π/P	3·142	1·571	1·047	·7854	·5236
K_2	$\frac{\pi/P}{\sqrt{2}\sin \pi/P}$	—	—	·8551	·7854	·7404

period will be found, and account will be taken of the number of times the half period occurs per cycle for various numbers of rectifier phases. I have found by trial that the solution is simplified slightly by considering the wave-form of the rectifier voltage as cosine instead of, as usual, sine, and the datum line along the time axis will therefore be at a point of maximum voltage. The element to be integrated therefore lies between O and α in Fig. 1 (*c*).

Reverting to the design calculations, the position is that B (the battery voltage) and C (the charging voltage required) are known, and it is required to find R (the maximum value of the AC voltage).

The rectifier voltage $= R \cos \theta$, where R is the voltage at the datum line, *i.e.* the maximum voltage, and θ is any angle between O and $\pi/2$ measured from this line.

Let B = the battery voltage and α the angle in radians, measured from the datum line, at which the rectifier voltage curve crosses the battery voltage line, *i.e.* where the rectifier and battery voltages are equal. Then

$$R \cos \alpha = B, \therefore R = \frac{B}{\cos \alpha} \quad \ldots\ldots\ldots\ldots (1)$$

$$\text{and R r.m.s.} = \frac{B}{\sqrt{2}\cos \alpha} = \frac{B}{X} \quad \ldots\ldots\ldots (2)$$

where $X = \sqrt{2}\cos \alpha$.

It now remains to obtain an expression for α, or preferably $\sqrt{2}\cos \alpha$, in terms of B and the other variable, C. The total area between

$$O \text{ and } \alpha = \int_0^{\alpha} R \cos \theta \, d\theta \ldots\ldots\ldots\ldots (3)$$

The area below the battery voltage line and between O and $\alpha = B\alpha \ldots\ldots\ldots\ldots (4)$

The area above the battery voltage line, which represents the charging voltage $= (3) - (4) = \int_0^{\alpha} R \cos \theta \, d\theta - B\alpha$.

Reference to Fig. 1 will show that there are two of these areas per rectifier phase per cycle. The total shaded area per cycle is therefore $2P \int_0^{\alpha} R \cos \theta \, d\theta - B\alpha$, where P is the number of rectifier phases.

Dividing the area thus obtained by the horizontal axis—the value of which, for one cycle, is 2π radians—we get the average vertical ordinate, which represents the average charging voltage. Therefore

$$C = \frac{2P}{2\pi}\left[\int_0^{\alpha} R \cos \theta \, d\theta - B\alpha\right] =$$

$$\frac{P}{\pi}\left[\int_0^{\alpha} R \cos \theta \, d\theta - B\alpha\right] \ldots\ldots\ldots\ldots (5)$$

$$= \frac{P}{\pi}(R \sin \alpha - B\alpha) \therefore R \sin \alpha - B\alpha = \frac{\pi}{P}C.$$

It has been shown (equation (1)) that $R = B/\cos \alpha \therefore \frac{B \sin \alpha}{\cos \alpha} - B\alpha = \frac{\pi}{P}C$

$$\therefore \tan \alpha - \alpha = \frac{\pi}{P} \cdot \frac{C}{B} \therefore Y = K_1 \frac{C}{B} \quad \ldots\ldots (6)$$

where $Y = \tan \alpha - \alpha$ and $K_1 = \frac{\pi}{P}$.

A straightforward expression for α or $\sqrt{2}\cos \alpha$ cannot be obtained from this formula, and it is recommended that a modified trigonometrical table—Table 2—be prepared, to enable $\sqrt{2}\cos \alpha$ to be obtained from $\tan \alpha - \alpha$. This table can be derived from a standard trigonometrical table.

The figures for angles approaching 90 deg. will not be required as they do not occur in

TABLE 2 (Sample figures)

α degrees	α radians	$\sqrt{2}\cos \alpha$ X	$\tan \alpha - \alpha$ Y
0	0	1·414	0
10	·1745	1·393	·0018
20	·3491	1·329	·0149
30	·5236 $\left(\frac{\pi}{6}\right)$	1·225	·0538
45	·7854 $\left(\frac{\pi}{4}\right)$	1·000	·2146
60	1·047 $\left(\frac{\pi}{3}\right)$	·7071	·6849

practice. Also, the figures for each degree need not be calculated for low angles as they increase very slowly. A table for angles of 0, 10, 14, 17, 20, 22, 24, 26, 28 and 30 to 60 (inclusive) degrees, will therefore be found adequate. $\pi/6$, $\pi/4$ and $\pi/3$ marked against the radian figures corresponding to 30, 45 and 60 deg. respectively will facilitate checking whether α is greater or less than π/P, when this is necessary.

The method of calculation is first to calculate Y from the known values of B and C, using equation (6) (the appropriate value of K_1 is obtainable from Table 1); X is then

obtained from Y, using Table 2, and this value is substituted in equation (2), enabling R r.m.s. to be determined.

The foregoing method of calculation is not applicable to Case 2, as an essential requirement is that there shall be an instant (α) when the rectifier voltage equals the battery voltage.

The calculation is, however, simpler than for Case 1, as the output voltage wave-form is not affected by the battery voltage, and the absence of this complication enables a direct formula to be derived.

This formula is derived as follows:—The element to be integrated lies between O and π/P in Fig. 2, from which it will be seen that equation (5) for Case 1 is applicable except that π/P must be substituted for α, *i.e.*,

$$C = \frac{P}{\pi}\left[\int_0^{\frac{\pi}{P}} R \cos\theta \, d\theta - \frac{\pi}{P} B\right] = \frac{P}{\pi}\left(R \sin\frac{\pi}{P} - \frac{\pi}{P} B\right); \therefore R = \frac{\frac{\pi}{P}}{\sin\frac{\pi}{P}}(B + C)$$

and R r.m.s. $=$

$$\frac{\frac{\pi}{P}}{\sqrt{2}\sin\frac{\pi}{P}}(B + C) = K_2 (B + C) \quad \ldots\ldots\ldots (7)$$

where $K_2 = \dfrac{\frac{\pi}{P}}{\sqrt{2}\sin\frac{\pi}{P}}$ and is obtainable from Table 1.

If there is doubt whether a particular example should be treated as Case 1 or Case 2, Y should first be calculated, using equation (6). Table 2 should then be referred to, to see whether α is more or less than π/P. If less, Case 1 applies; if the same or more, Case 2.

Forthcoming Events

Friday, October 20th.—*London.*—At Institution of Electrical Engineers, 5.30 p.m. Measurements Section. Inaugural address by Dr. W. G. Radley.

London.—Institution of Mechanical Engineers, 5.30 p.m. Presidential address on "Applied Research," by Dr. H. R. Ricardo.

London.—39, Victoria Street, S.W.1, 6.30 p.m. Junior Institution of Engineers. Informal meeting. "Humidity and its Control," by M. R. G. Morton.

Newcastle-on-Tyne.—Neville Hall, Westgate Road, 6.30 p.m. I.E.E. North-Eastern Students' Section. Inaugural address by the chairman, G. E. Topping.

Newcastle-on-Tyne.—At Literary and Philosophical Society's Lecture Theatre, 6 p.m. North East Coast Institution of Engineers and Shipbuilders. Annual general meeting and presidential address.

Sheffield.—At Metallurgical Club, West Street, 6.30 p.m. Junior Institution of Engineers (Sheffield Section). Annual meeting and informal discussion.

Saturday, October 21st.—*London.*—At Lighting Service Bureau, 2, Savoy Hill, W.C.2, 2.15 p.m. Association of Supervising Electrical Engineers. Technical film display and presidential address.

Birmingham.—Grand Hotel, 12.30 for 1 p.m. I.E.E. South Midland Centre. Wartime lunch. Chairman's address and visit of Institution president.

Wakefield.—Strafford Arms, 3 p.m. Association of Mining Electrical and Mechanical Engineers. Presidential address by J. T. Green and visit by the national president.

Cardiff.—At South Wales Institute of Engineers, 5 p.m. Association of Mining Electrical and Mechanical Engineers (South Wales Branch). "Electrical Aspects of American Mechanical Loading of Coal" (illustrated by sound film and slides), by R. Crawford.

Monday, October 23rd.—*London.*—At I.E.E., 5.30 p.m. Informal meeting. Discussion on "The Engineer's Part in Certain Post-War Problems," to be opened by the president.

Birmingham.—Grand Hotel, 6 p.m. Birmingham Electric Club. Paper on "High-frequency Induction Heating," by T. G. Tanner.

Newcastle-on-Tyne.—Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "Design and Performance of Domestic Electrical Appliances," by W. N. C. Clinch and F. Lynn.

Tuesday, October 24th.—*London.*—At I.E.E. Council Room, 2.30 p.m. British Society for International Bibliography. "The Application of Universal Decimal Classification to Telecommunication Literature," by Mr. J. E. Wright, and "Document Classification in a Limited Field—Radiocommunication and Allied Subjects," by Mr. L. S. Harley.

Wednesday, October 25th.—*London.*—At I.E.E., 5.30 p.m. Radio Section. "Development of Polythene as a High-frequency Dielectric," by Prof. Willis Jackson and J. S. A. Forsyth.

Edinburgh.—Heriot-Watt College, 6 p.m. I.E.E. Scottish Centre. Exploratory wireless meeting. Paper: "Survey of the Performance of Post-War Television," by B. J. Edwards.

Birmingham.—At James Watt Institute, 6.30 p.m. I.E.E. South Midland Students' Section. "Diesel Electric Traction," by F. L. Toombs.

Doncaster.—Technical College, 3 p.m. Association of Mining Electrical and Mechanical Engineers (Yorkshire S.E. and N.W. Branches). Visit by H.M. Electrical Inspector of Mines and discussion on his report.

Newcastle-on-Tyne.—Bolbec Hall, 6.45 p.m. North East Coast Institution Student Section. Chairman's address.

Friday, October 27th.—*London.*—At Institution of Civil Engineers, 3 p.m. Institution of Chemical Industry, Chemical Engineering Group. Fifth Hinchley Memorial Lecture: "Hydro-electric Development in Great Britain and its Influence on Chemical and Allied Industries," by Sir Alexander Gibb.

London.—Institution of Mechanical Engineers, 5.30 p.m. Informal discussion on "The Influence of Engineering on Social Advancement," to be introduced by E. Reeve.

Monday, October 30th.—*Birmingham.*—At James Watt Institute, 6 p.m. I.E.E. South Midland Centre Radio Group. Discussion on "Industrial Applications of High-frequency Power," to be opened by E. May.

RECENT INTRODUCTIONS

Notes on New Electrical and Allied Products

Signalling Torch

A MARINE torch for night signalling is announced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. It is weatherproof and made partly of steel specially treated to resist rust. The head ring

Marine signalling torch

and base cap, which embody screw threads, are made of brass. The whole is finished in black rivelling enamel.

The head of the torch is fitted with a light-restricting cowl and colour screen for night signalling. These are detachable and, without either or both of them, the large diameter reflector with focusing device gives a strong spotlight beam. The bulb holder has a spring plunger, so that the bulb can be unscrewed to the last thread before contact is broken.

The torch is fitted with a Morse tapper key and a thumb switch; with the former locked in the closed position by means of a sliding tube, the torch may be used in the normal way. The thumb switch also acts as a safety feature to prevent accidental flashing of the tapper key. Additional refinements include a carrying handle, which also forms a stand for signalling, and a spare bulb holder.

It has an overall length of 11 in., and is designed to take an "Osram" 2-V, 0·3-A bulb, operating from two L.6103 battery cells. It has been approved by the Admiralty for use as a night signalling torch on merchant ships, and by the Ministry of War Transport for lifeboats and for use in similar circumstances.

Larder Conditioner

To provide safe food storage conditions in kitchens not large enough to accommodate refrigerators, FRIGIDAIRE, LTD., 401, Edgware Road, The Hyde, London, N.W.9, has designed a "larder conditioner." A small fan over a specially designed cooling coil contained within the unit circulates the air within the larder and removes all food odours. Clean cool air then flows round the larder maintaining the temperature at less than 50 deg. F. with appropriate relative humidity both winter and summer. Under these conditions even bread and green vegetables can, it is claimed, be kept for reasonable periods in perfect condition.

The apparatus, which will cool an entire larder of 25-30 cu. ft., is operated by an electrical rotary sealed compressor designed to run for years without attention. There are no switches to set, no oiling to be carried out and no periodic de-frosting. Larders need to be lightly insulated, and have standard flush doors packed internally with kapok. It is anticipated that the cost of the unit will be considerably less than the pre-war family model refrigerator. Electricity consumption is approximately 2 kWh a day.

This equipment and a proposed standard 3-kW fused plug are two of the outstanding electrical items in an exhibition now running at Birmingham under the auspices of the Ministry of Works. It is a display of housing equipment to illustrate those parts of the "Housing Manual, 1944" which deal with interior installations and fittings. The exhibition is complementary to the demonstration houses at Northolt, which illustrate Government recommendations on the planning and construction of houses. It has been arranged with the co-operation of the Ministry of Health and the Ministry of Fuel and Power. The exhibition is being held at the West End Hall, 92, Suffolk Street (near the Civic Centre). From October 16th to 21st inclusive admission

Frigidaire "larder conditioner."

will be by ticket only. From October 23rd to November 4th, inclusive, the exhibition will be open to the public from 10 a.m. to 5 p.m. each day (including Saturdays).

West Hartlepool Model Kitchen

THE borough electrical engineer of West Hartlepool (Mr. S. Tillotson) has designed a model kitchen which includes suggestions made by housewives who inspected a previous model. Mr. Tillotson's model, which is open for public inspection, can be incorporated in the houses of 900 sq. ft. proposed by the Government. The kitchen covers 164 sq. ft. and has a laundry adjoining.

ELECTRICITY SUPPLY

Breakdown at Douglas. Hamilton Ban Removed.

Bradford.—POWER STATION EXTENSIONS.—The Electricity Commissioners have approved a scheme for extensions at Valley Power station estimated to cost £1,000,000. Half of the extensions have to be completed by 1946 and the remainder by 1948. The contract has been let for a new turbo-alternator, and preparations are being made for the installation of two new boilers.

Cardiff.—SUBSTATION.—The Electricity Committee is to obtain a substation site in Grand Avenue, Ely.

Chesterfield.—BULK SUPPLY ARRANGEMENTS.—In connection with a scheme for additional bulk supplies from the Derbyshire & Nottinghamshire Electric Power Co., involving the erection of an additional 5,000-kW bulk supply plant, the Electricity Committee has decided to seek sanction to borrow £12,365.

SUPPLY TO PUMPING STATION.—The borough electrical engineer has reported to the Electricity Committee that as the Electricity Commissioners are not prepared to grant the necessary licence for the erection of steel lattice towers for the high-voltage line to the Holmebrook pumping station, a new scheme has been prepared incorporating wooden poles and this, with a revised schedule of costs, has been submitted to the Commissioners.

Douglas (I.O.M.).—ACCIDENT AT POWER STATION.—A flywheel, weighing about 20 tons, flew off the generator at the power station on October 10th and, as a result, the whole of the island was deprived of a supply of electricity. The flywheel wrecked part of the station as it hurtled through the roof, then it broke up in mid air and fell in various parts of Douglas after travelling nearly half a mile. Many people had narrow escapes but nobody was hurt. Workmen in the station suffered from shock. Two pieces of the flywheel badly damaged the office of the *Isle of Man Times*. One piece went through the five-storey building and destroyed a Diesel engine, and another piece wrecked much of the building. An electricity supply was later brought into operation in the island by means of emergency plant.

Essex. — ELECTRICITY FAILURE. — Southend and most of the S.E. Essex towns and villages were affected by a failure of the electricity supply last Saturday night. There was a complete black-out for twenty-five minutes.

Dumbarton. — ADMINISTRATION OF UNDERTAKING.—There are indications that Dumbarton Town Council intends to exercise its option to terminate its agreement with the Electric Supply Corporation for the supply of electricity in the burgh. In reply to an inquiry the Clyde Valley Electrical Power Co. has submitted proposals in the event of the Council's exercising its option. One proposal is that the Council should continue to be the electricity undertakers and enter into an agreement for the Clyde Valley Co. to operate the undertaking, the company to provide the capital for the acquisition and future extension with a 40 years' agreement. The second is that the Dumbarton Electric Lighting Order of 1920 should be transferred to and merged into the whole undertaking of the Clyde Valley Co. without expenditure by the Council. In the event of either proposal being accepted the supply to consumers would be at the standard rates operating throughout the area served by the Clyde Valley Co.

Glasgow.—SUPPLY TO FARMS.—It is recommended that the Corporation shall contribute £250 towards the cost of a high-voltage overhead line to be erected by the Clyde Valley Electrical Power Co. to supply farms in the East Kilbride area. The proposed contribution is in respect of the inclusion of one of the Corporation's farms.

Hamilton.—BAN ON CHOICE REMOVED.—In 1934 the Town Council approved resolutions of a joint meeting of the Gas and Electricity Committees as a result of which tenants of new houses were not allowed to use electricity for heating and cooking. At its last meeting the Council decided to lift this ten-year ban by rescinding the former resolutions. It was agreed that, in all houses belonging to the Council, tenants should be free, subject to the approval of the Housing Committee, to introduce electricity and to make whatever use of that medium they choose.

Hull.—POWER STATION EXTENSIONS. — The Electricity Committee has obtained sanction to borrow £750,000 for extensions at the power station. It is also applying for permission to borrow £20,000 for mains and £10,000 for substations.

INDUSTRIAL SUPPLIES.—To meet the increased demand from industrial consumers in suburban areas works are to be carried out by the Committee at an estimated cost of £9,213.

Lichfield. — PRICE INCREASE WAIVED. — The Electricity Committee recommends that the 10 per cent. war increase in prices shall be not charged in respect of the September quarter.

Newport (Mon.).—LOWER CHARGES RECOMMENDED.—Following a report by Mr. T. H. Wood, who was appointed borough electrical engineer and manager earlier this year, the Electricity and Transport Committee has recommended the halving of the temporary 10 per cent. increase in charges made in 1940. The Committee has congratulated Mr. Wood and his staff on the results shown in the report on the past year's trading.

Northern Ireland.—DEVELOPMENT SCHEME.—The Electricity Board for Northern Ireland has submitted to the Ministry of Commerce for confirmation under the Electricity (Supply) Act (Northern Ireland), 1931, a development scheme in parts of Antrim and Derry. The scheme is made with the general object of promoting, co-ordinating and improving the supply, distribution and sale of electricity in the development area as and when conditions permit, and gives the Board power to acquire and link-up with its main transmission lines all existing undertakings as and when desirable.

Notice has been given that authorised undertakings or other persons interested may make representations to the Ministry of Commerce with respect to the scheme within a month. A resolution protesting strongly against the proposal of the Board to acquire the municipally-

owned Portstewart undertaking as part of the scheme has been passed at a special meeting of Portstewart Council.

Stretford.—CHARGES REDUCED.—The Stretford and District Electricity Board has reduced the lighting flat rate from 4½d. plus 5 per cent. to 3¾d. per kWh; the heating rate from 1¼d. to 1d.; power charges from 65 to 50 per cent. over the sliding scale; and the domestic "all-in" tariff running charge from ¾d. to ½d.

Tynemouth.—SUPPLY TO TRADING ESTATE.—In connection with electricity supply to the Chirton Trading Estate, the Electricity Committee has agreed that until experience has been gained of the manufacturers' requirements the electricity supplied to their new premises shall be charged on the maximum demand terms, namely, £4 5s. per kW of m.d. per annum plus ½d. per kWh subject to an addition or reduction of 0·01d. per kWh supplied for each shilling by which the cost of coal for the calendar year is above or below 12s. per ton.

West Bromwich.—SHOWROOM ALTERATIONS.—Proposed alterations to the electricity showrooms and reconstruction of adjoining premises at an estimated cost of £11,000 have been approved by the Town Council. The scheme is now being submitted to the Electricity Commissioners.

Wigan.—FARM ELECTRIFICATION.—The Rural District Council has approved plans of the Lancashire Electric Power Company for supplying electricity to seven farms.

Overseas

Belgium. — ELECTRICITY IN BRUSSELS RESTRICTED.—Warning has been given that electricity in Brussels is to be cut off from sunrise to sunset because of the coal shortage. Supplies will continue to vital services such as hospitals, flour mills, bakeries and newspapers. If coal supplies permit, the electricity services will be restored at certain hours of the day for cooking.—*Reuter.*

New Zealand.—PLANT EXTENSIONS.—It is reported in *Tenders* that the Auckland Electric Power Board is supplying its consulting engineers in London with specifications and orders covering various items of electrical equipment required for proposed extensions, together with instructions for inviting tenders.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

The Calcutta Tramways Co., Ltd.—No estimate of the purchase price which the Calcutta Corporation will pay on acquiring the undertaking on January 1st next could be given by Sir Geoffrey R. Clarke, the chairman, at the company's annual general meeting on October 10th. The purchase price is to be based on the income and working expenses for a period of years ending with the current year; when the accounts have been completed the price will be ascertained and settled either by agreement or, if necessary, by arbitration. Sir Geoffrey said that apart from the separate Howrah system, which was constructed under agreement with the Howrah municipality, there were certain portions of the Calcutta system vital to its working which lay outside the scope of the contract and did not therefore fall within the terms of purchase. Acquisition of these portions would involve legislation. During the year two extensions were completed and opened for traffic, one to Ballygunge and the other to Howrah station across the new Howrah bridge.

A. Reyrolle & Co., Ltd., are offering ordinary stockholders 189,330 new £1 ordinary shares at 60s. each in the proportion of one new share for each complete multiple of £4 7s. 6d. of ordinary stock held. The proceeds of the issue are to be used to repay bank loans and to provide for commitments now in hand.

Telephone Properties, Ltd., report an income amounting to £87,309 for the year 1943, as compared with £94,216, for 1942. Almost all of this sum was in respect of dividends and interest from the Venezuelan subsidiary. The net profit was £30,968 (£24,503). A dividend of 6 per cent. (nil) is to be paid, and reserve for contingencies again receives £5,000, leaving £42,549 (£40,450) to be carried forward. Mr. A. N. Rye, the deputy chairman, stated at the general meeting on October 24th that there was a wide field for telephone expansion in Venezuela, and the Nacional Company planned large extensions immediately equipment became available.

The British Vacuum Cleaner & Engineering Co., Ltd., reports a gross profit of £155,059 for the year ended September 30th last, as compared with £149,730 in the previous year. After the deduction of bank interest, directors' fees, income tax and N.D.C., the net profit is £88,640 (against £95,888). A sum of £54,000 (£55,000) is transferred to income tax reserve, while the staff pension fund receives £7,500 (£10,000). A final dividend of 17½ per cent. makes 30 per cent. for the year (same) and £12,202 (£11,687) is carried forward.

The United River Plate Telephone Co., Ltd., in a preliminary statement for the six months ended June 30th, 1944, records gross earnings amounting to £2,659,604, as compared with £2,504,603 for the first half of 1943, the net income being £588,054 (£542,511).

Erinoid, Ltd., proposes to increase its capital from £330,000 to £750,000 by the creation of 420,000 £1 shares. No immediate issue is proposed. The net profit for 1943-44 was £16,802 (against £15,974) and the dividend is being maintained at 10 per cent.

Electric & Musical Industries, Ltd., state that the group's net profit for the past year was £182,024, comparing with £174,357 for the preceding twelve months. The ordinary dividend is maintained at 8 per cent. (including 2 per cent. bonus) less tax at 8s. 6d. in the £.

Strand Electric Holdings, Ltd., besides maintaining its dividend at 10 per cent. is paying a bonus of 2½ per cent.

Marconi's Wireless Telegraph Co., Ltd., has declared an interim dividend of 3½ per cent. (same).

The Marconi International Marine Communication Co., Ltd., is again paying an interim dividend of 2½ per cent.

The Skefko Ball Bearing Co., Ltd., has declared an interim dividend of 6¾ per cent., tax free (same).

The River Plate Electricity & Other Securities Corporation, Ltd., is again to pay an interim dividend of 2 per cent.

Callender's Cable & Construction Co., Ltd., is maintaining its interim dividend at 5 per cent.

The John Thompson Engineering Co., Ltd., is paying an interim dividend of 5 per cent. (same).

The British Thermostat Co., Ltd., proposes to maintain its interim dividend at 7½ per cent.

W. B. Dick & Co. (Holdings), Ltd., has maintained its dividend at 4 per cent.

New Companies

R. J. Stearn & Sons (Luton), Ltd.—Private company. Registered October 4th. Capital, £3,000. Objects: To acquire the business of electricians formerly carried on by the late R. J. Stearn and F. C. White at 19, Upper George Street, Luton, and to carry on the business of electrical and wireless engineers and dealers, etc. Directors: R. G. Stearn, 16, Sharpenhoe Road, Barton, Beds., H. L. Stearn and W. A. Stearn, both of 38, Westbourne Road, Luton. Registered office: 19, Upper George Street, Luton.

Insuloid Manufacturing Co., Ltd.—Private company. Registered October 5th. Capital, £5,000. Objects: To carry on the business of manufacturers of, and dealers in, insulating plastic and other paper materials, rubber, synthetic rubber and covered textile yarns, and goods made therefrom or treated therewith, radio sets, electrical goods, etc. Directors: E. F. Emery, West Lodge, Butley Road, Adlington, Cheshire; and F. D. Emery, 6, Beech Road, Cheadle Hulme, Cheshire. Registered office: Ford Street Mill, Chestergate, Stockport.

Glenmill Radio and Electrical Co., Ltd.—Private company. Registered October 5th. Capital, £2,000. Objects: To carry on the business of manufacturers of, and dealers in, wireless, television and electrical goods, etc. Directors: Lieut. G. W. Brown Mills (formerly Gerald W. Brown), 16, Linden Road, Gosforth, Newcastle-on-Tyne and W. R. Bell, 81, Selsea Avenue, Herne Bay. Registered office: 109a, Mortimer Street, Herne Bay.

Companies' Returns

Statements of Capital

Burgess Hill Electricity, Ltd. — Capital, £65,000 in £1 shares (all ordinary). Return dated May 3rd. 52,250 shares taken up. £50,400 paid. £1,850 considered as paid. Mortgages and charges: Nil.

Prince's Electrical Clocks, Ltd.—Capital, £3,000 in £1 shares. Return dated May 16th. All shares taken up. £1,000 paid. £2,000 considered as paid. Mortgages and charges: Nil.

East Suffolk Electricity Distribution Co., Ltd.—Capital, £125,000 in £1 shares. Return dated March 28th (filed May 3rd). All shares taken up. £135,000 paid (including 16s. 8d. per share premium on 12,000 shares). Mortgages and charges: £7,900.

Increase of Capital

Electroway Heaters, Ltd.—The nominal capital has been increased by the addition of £5,000 beyond the registered capital of £5,000. The additional capital is divided into 2,000 ordinary and 3,000 6 per cent. preference shares of £1 each.

Mortgages and Charges

C. O. Ericsson Engineering Works, Ltd.—Debenture charged on deeds and documents relating to properties in King's Norton and Sutton Coldfield, and the company's undertaking and other property, present and future, including uncalled capital, dated September 23rd, 1944, to secure all moneys due or to become due from the company to Lloyds Bank, Ltd.

Sunderland Engineering Equipment Co., Ltd.—Assignment of proceeds of contracts, dated September 14th, 1944, to secure all moneys due or to become due from the company to Martins Bank, Ltd.

General Installation Co., Ltd.—Satisfaction in full on August 22nd, of debenture dated October 1st, 1931, and registered October 8th, 1931, securing £100.

Liquidations

Dome Electric Co., Ltd.—Meeting October 21st, at the office of Harry L. Price & Co., 47, Mosley Street, Manchester, to receive an account of the winding up by the liquidator, Mr. A. T. Eaves.

Bankruptcies

T. Smith, Jun., radio dealer, carrying on business at 19, Risborough Lane, Charlton, as the Risborough Radio Service, and at 5, Prospect Road, Hythe, as Hythe Music Stores. —Application for discharge to be heard on November 14th at the Guildhall, Canterbury.

R. E. Pearcey, motor and electrical engineer, 105, Arthur Street, Withernsea.—Discharged as from September 20th, 1944.—Proofs for dividends by October 27th to the trustee, Mr. J. E. D. Stickney, 1, Parliament Street, Hull.

H. A. Mayhew, electrical contracting engineer, 96, London Road, Apsley, Herts and 30, Elmer Gardens, Edgware.—Order made September 19th for discharge subject to debtor's consenting to judgment for £25 being entered against him by the Official Receiver.

J. H. Matthews, electrical dealer, 232 Town Street, Bramley, near Leeds.—Supplemental dividend of 5s. 2d. in the £ payable October 27th at the Official Receiver's Office, 24A, Bond Street, Leeds.

K. G. Burfield, electrical contractor, Espere, Couchmore Avenue, Clayhall Avenue, Ilford. —Receiving order made October 6th, on a creditor's petition.

STOCKS AND SHARES

TUESDAY EVENING.

STOCK Exchange prices are better than the amount of business which is now going on in the House, for prices are well maintained though the volume of business being transacted is certainly small. Every now and then a spasm of activity occurs in one market or another. This week it has been the radio department that has attracted most attention, a sharp rise in Electric & Musical Industries giving impetus to the list as a whole. For the best-class industrial shares a consistent demand continues.

Price Fluctuations

The variation in prices this week is comparatively slight. Home Railway firmness is reflected in a point rise, to 75, in Southern 5 per cent. preferred. The prior-charge group is better, too, but nominal quotations have been left unchanged. London Passenger Transport issues show no alteration, although to buy the fixed-interest stocks is a matter of increasing difficulty. Preference shares in the Home electricity supply group are also none too easy to come by. Montreal Power at 22½ is 1 lower, but Shawinigans hardened to 16½. Tokyo Electric sixes, the recent speculative buyers being satisfied, went back to 26. Cawnpore Electrics at 39s. 3d. have lost 9d. Calcutta Electric Supply remain at 47s.

Miscellaneous Movements

The Strand Electric surprised and pleased its proprietors by declaring a bonus of 2½ per cent. in addition to 10 per cent. dividend. This is 2½ per cent. better than last year's distribution. The price of the 5s. shares at 10s. 9d. is 2s. higher. Murex at 4¾ have recovered the deduction of the dividend. British Insulated at 5⅜ and Mather & Platt at 2⅜ are both ⅛ up. Automatic Telephones and Walsall Conduits gained 6d. Cable & Wireless stocks are easier. Marconi Marines held to 36s. upon announcement of the usual interim dividend of 2½ per cent. Telephone Properties at 21s. 3d. are quoted ex dividend. British Vacuum Cleaner are also ex dividend at 29s. The year's accounts show a slight decrease in the trading profits, but the 30 per cent. dividend on the ordinary shares is comfortably covered. Peto Scott Electrical Instruments at 4s. 9d. have fallen a trifle.

Callender's Cable

Callender's Cable & Construction Co., in declaring the usual 5 per cent. interim dividend, continues a rate which has been distributed annually for years past. The final, in each of the past two years, has been 10 per cent., plus a bonus of 5 per cent., making in all 20 per cent. for the year, this being the same rate as was declared for 1936 and 1937. For 1938 to 1941 inclusive, the annual dividend was 15 per cent., all these dividends having been paid out of earnings substantially greater. The company's year ends with December and the last-published accounts showed Callender's to be in an extremely strong financial position, the net liquid assets being rather over £1,000,000. The shares afford a yield of £3 16s. 2d. per cent. on the money at the present price of 5¼, which, by the way, compares with 1⅞ touched in the dark days of 1941.

E.M.I.

Electric & Musical Industries shares rose to 37s. an hour or two before the company announced a dividend and bonus making, as before, 8 per cent. for the year. By some misunderstanding the figures were not sufficiently clearly stated for them to be readily comparable with those of the previous year. The result was a fall next morning to 35s. 6d. and, although the company promptly telephoned to the Stock Exchange a re-statement of the announcement, making clear what was previously obscure, the price of the shares failed to recover to the overnight level. At 36s., they show a gain of ⅛ on the week.

The market in radio shares is tolerably active. Cossor at 25s. 6d. and E. K. Cole at 33s. are 6d. and 1s. better respectively. Pye deferred shares are unchanged at 33s. 9d. So far as E.M.I. is concerned, it really matters little what current dividend the company pays or what the earnings are under present conditions; supporters of the shares look to the future development of television as likely to justify the faith which they repose in their investment.

De La Rue

Thomas De La Rue shares have risen to the highest price reached for many years, the £1 shares advancing to 9⅝. This is connected with the drastic action of the Belgian Government in withdrawing all the previous notes in circulation, and substituting fresh notes. De La Rue has interests in the plastics business and, after the war, this branch is expected to yield substantial results. But in the meantime the security printing is that part of the company's activities which produces the major part of its profits. De La Rue shares stood at 25s. three years ago and are now, as just mentioned, 192s. 6d. For the year ended March 31st, 1941, no dividend was paid. In the following year, the dividend was 25 per cent., and for the period ending last March, 40 per cent. The yield on the shares at the present price is about 4¼ per cent.

Atlas Electric

With a fall of 3d., Atlas Electric & General Trust eased off to 7s. 3d. Two or three thousand of the Trust's 7 per cent. preference shares have come on offer at 26s. 3d., showing

(*Continued on page* 574)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend Previous	Dividend Last	Middle Price Oct. 17	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies					
Bournemouth and Poole ..	12½	12½	64/6	..	3 17 4
British Power and Light ..	7	7	33/6	..	4 3 7
City of London ..	7	5½	30/–	..	3 13 4
Clyde Valley ..	8	8	42/–	..	3 16 0
County of London	8	8	44/6	..	3 12 1
Edmundsons :					
7% Pref. ..	7	7	35/6	..	3 19 0
Ord.	6	6	31/–	..	3 17 5
Elec.Dis.Yorkshire	9	9	45/6	..	3 19 6
Elec. Fin. and Securities ..	12½	13½	60/–	..	4 10 0
Elec. Supply Corporation ..	10	10	48/6	..	4 2 4
Isle of Thanet ..	Nil	Nil	19/6	..	—
Lancs. Light and Power	7½	7½	37/–	..	4 1 1
Llanelly Elec. ..	6	6	26/6	..	4 10 7
Lond.Assoc.Electric	3	4	26/–	..	3 1 6
London Electric..	6	6	30/6	..	3 18 8
LondonPowerRed. Deb.	5	5	103½	..	4 16 7
Metropolitan E.S.	8	8	44/–	..	3 12 9
Midland Counties	8	8	41/6	..	3 17 0
Mid. Elec. Power	9	9	44/6	..	4 1 0
Newcastle Elec...	7	7	31/6	..	4 9 0
North Eastern Elec.: Ordinary ..	7	7	35/–	..	4 0 0
7% Pref. ..	7	7	35/–	..	4 0 0
Northampton ..	10	10	50/–	..	4 0 0
Notting Hill 6% Pref. (£10) ..	6	Nil	10½	..	—
Northmet Power : Ordinary ..	7	7	43/6	..	3 4 4
6% Pref. ..	6	6	30/6	..	3 18 8
Richmond Elec.	6	6	26/–	..	4 12 4
Scottish Power ..	8	8	40/6	..	3 19 0
Southern Areas	5	5	23/–	..	4 7 0
South London ..	7	7	29/–	..	4 16 7
West Devon ..	5	5	23/6	..	4 5 1
West Glos. ..	4½	3½	25/–	+6d.	2 16 0
Yorkshire Elec...	8	8	43/–	..	3 14 5
Public Boards					
Central Electricity : 1955–60 (Civil Defence) ..	3	3	100	..	3 0 0
1955–75 ..	5	5	114½	..	4 7 4
1951–73 ..	4½	4½	107	..	4 4 1
1963–93 ..	3½	3½	104½	..	3 7 0
1974–94 ..	3½	3½	100	..	3 5 0
London Elec. Trans. Ltd.	2½	2½	98½	..	2 10 9
London & Home Counties 1955–75.	4½	4½	112	..	4 0 4
Lond.Pass.Trans.Bd. A	4½	4½	120½	..	3 14 8
B	5	5	121½	..	4 2 4
C	3	3½	68	..	4 15 7
WestMidlandsJ.E.A. 1948–68 ..	5	5	106½	..	4 14 0

Company	Dividend Previous	Dividend Last	Middle Price Oct. 17	Rise or Fall	Yield p.c. £ s. d.
Overseas Electricity Companies					
Atlas Elec. ..	Nil	Nil	7/3	–3d.	—
Calcutta Elec. ..	6*	6*	47/–	..	2 11 1
Cawnpore Elec.	10	7	39/3	–9d.	3 11 4
East African Power	7	7	34/6	.. ..	4 1 4
Jerusalem Elec...	7	5	29/–xd	..	3 9 0
Kalgoorlie (10/–)	5	5	11/6	..	4 7 0
Madras Elec. ..	Nil	4	29/6xd	..	2 14 4
Montreal Power	1½	1½	22½	–1	—
PalestineElec."A"	5*	5*	40/–	..	2 10 0
Perak Hydro-elec.	6	7	13/6	..	—
Shawinigan Power	83cts.	90cts.	16¼	+¼	—
Tokyo Elec. 6%	6	6	26	–1	—
VictoriaFallsPower	15	15	4½	..	3 10 7
WhitehallInv.Pref.	—	6	25/6	..	4 14 0
Equipment and Manufacturing					
Aron Elec. Ord.	10	15	61/–	..	4 18 4
Assoc. Elec. : Ord.	10	10	51/6	+6d.	3 17 4
Pref. ..	8	8	39/–	..	4 2 0
Automatic Tel.&El.	12½	12½	61/–	+6d.	4 2 0
Babcock & Wilcox	11	11	49/6	..	4 8 9
British Aluminium	10	10	47/–	..	4 5 1
British Insul. Ord.	20	20	5⅝	+⅛	3 14 6
British Thermostat (5/–)	18½	18½	20/–	..	4 12 6
British Vac. Cleaner (5/–)	30	30	29/–xd	+6d.	5 3 5
Brush Ord. (5/–)	8	9	10/9	..	4 3 9
Burco (5/–) ..	15	17½	17/–	..	5 3 0
Callender's ..	15	20	5½	..	3 16 2
ChloridеElec.Storage	15	15	87/6	..	3 8 7
Cole, E. K. (5/–)..	10	15	33/–	+6d.	2 5 6
Consolidated Signal	24	27½	6¾	..	4 3 6
Cossor, A. C. (5/–)	7½*	10*	25/6	+6d.	1 19 4
Crabtree (10/–) ..	17½	17½	41/–	..	4 5 4
Crompton Parkinson Ord. (5/–) ..	20	22½	32/–	..	3 7 3
E.M.I. (10/–) ..	6	8	36/–	+⅛	2 4 6
Elec. Construction	10	12½	57/–	..	4 7 9
Enfield Cable Ord.	12½	12½	61/–	..	4 2 0
English Electric	10	10	50/6	..	3 19 0
Ensign Lamps (5/–)	25	15	21/3	..	3 10 8
Ericsson Tel. (5/–)	22*	20*	51/3	..	1 19 1
Ever Ready (5/–)	40	40	41/–	..	4 17 5
Falk Stadelmann	7½	7½	34/6	..	4 7 0
Ferranti Pref. ..	7	7	31/3	..	4 9 7
G.E.C. : Pref.	6½	6½	32/9	..	3 19 4
Ord.	17½	17½	93/3	..	3 15 1
General Cable (5/–)	15	15	15/–	..	5 0 0
Greenwood&Batley	15	15	43/9	..	6 17 0
HallTelephone(10/–)	12½	12½	31/–	..	4 0 8
Henley's (5/–) ..	20	20	25/6xd	..	3 18 8
4½% Pref. ..	4½	4½	24/–	..	3 15 0
Hopkinsons ..	15	17½	69/3	..	5 1 1
India Rubber Pref.	5½	5½	23/–	..	4 15 9
Intl. Combustion	30	30	6¾	..	4 10 8
Johnson & Phillips	15	15	74/–	–1/–	4 1 0
Lancashire Dynamo	22½	22½	96/6	..	4 13 5
Laurence, Scott(5/–)	12½	12½	13/–	..	4 16 2

(*Continued on next page*)

* Dividends are paid free of Income Tax.

Company	Dividend Previous	Dividend Last	Middle Price Oct. 17	Rise or Fall	Yield p.c.
Equipment and Manufacturing (*Continued*)					£ s. d.
London Elec. Wire	7½	7½	37/6	..	4 0 0
Mather & Platt..	10	10	52/6	+½	3 16 2
Metal Industries (B)	8	8½	50/6	..	3 7 6
Met.Elec.CablePref.	5½	5½	21/3	..	5 3 6
Murex	20	20	95/-xd	+½	4 4 4
Pye Deferred (5/–)	25	25	33/9	..	3 14 5
Revo (10/–) ..	17½	17½	40/–	..	4 7 6
Reyrolle ..	12½	12½	70/–	–½	3 11 5
Siemens Ord. ..	7½	7½	35/–	..	4 5 9
Strand Elec. (5/–)	10	12½	10/9	+2/–	5 16 3
Switchgear & Cowans (5/–) ..	20	20	18/6	–6d.	5 8 1
T.C.C. (10/–) ..	5	7½	22/6	..	3 6 8
T.C. & M. ..	10	10	56/–	..	3 11 6
TelephoneMfg.(5/–)	9	9	11/6	..	3 18 3
Thorn Elec. (5/–)	20	20	25/–	..	4 0 0
Tube Investments	20	20	95/6	..	4 3 8
Vactric (5/–) ..	Nil	22½	16/6	..	6 16 3
Veritys (5/–) ..	7½	7½	8/–	..	4 13 9
Walsall Conduits(4/–)	55	55	50/–	+6d.	4 8 0
Ward & Goldstone (5/–)	20	20	30/–	..	3 6 8
WestinghouseBrake	12½	14	75/–	..	3 14 8
West, Allen (5/–)	7½	7½	7/6	–3d.	5 0 0
Traction and Transport					
Anglo-Arg. Trans. :					
First Pref. (£5)	Nil	Nil	2/6	..	—
4% Inc. ..	Nil	Nil	7½	..	—
Brit. Elec. Traction :					
Def. Ord. ..	45	45	1195	..	3 15 4
Pref. Ord. ..	8	8	180	..	4 9 0

Company	Dividend Previous	Dividend Last	Middle Price Oct. 17	Rise or Fall	Yield p.c.
					£ s. d.
Bristol Trams ..	10	10	57/–	..	3 10 2
Brazil Traction..	1½	2	26½xd	–½	7 9 7
Calcutta Trams	6½	7½	65/6	–2/–	2 5 9
Cape Elec. Trams	5	6	25/6	..	4 14 1
Lancs. Transport	10	10	45/6	..	4 8 0
Mexican Light :					
1st Bonds ..	5	5	105½	..	4 14 9
Rio 5% Bonds ..	5	5	106½	..	4 14 0
Southern Rly. :					
5% Prefd. ..	5	5	75	+1	6 13 4
5% Pref. ..	5	5	114½	..	4 7 4
T. Tilling ..	10	10	60/–	..	3 6 8
West Riding ..	10	10	46/–	..	4 7 0
Telegraph and Telephone					
Anglo-Am. Tel. :					
Pref. ..	6	6	123	..	4 17 7
Def.	1½	1½	30	..	5 0 0
Anglo-Portuguese	8	8	28/–	—	5 14 4
Cable & Wireless :					
5½% Pref. ..	5½	5½	115	–½	4 15 10
Ord.	4	4	81	–1	4 18 9
CanadianMarconi	$1 Nil	4cts.	9/–	..	—
Globe Tel. & Tel. :					
Ord.	8½*	5*	39/–xd	..	2 11 4
Pref. ..	6	6	30/6xd	+3d.	3 18 8
Great Northern Tel. (£10)	Nil	Nil	30	..	—
Inter. Tel. & Tel.	Nil	Nil	21½	..	—
Marconi-Marine..	7½	7½	36/–	..	4 3 4
Oriental Tel. Ord.	16	10	50/–	..	—
Telephone Props.	Nil	6	21/3xd	..	5 13 0
Tele. Rentals (5/–)	10	10	11/9	..	4 5 0

* Dividends are paid free of Income Tax.

Stocks and Shares (*Continued from page* 572)

a yield at that price of £5 6s. 6d. per cent. The margin of protection for the preference dividend, as measured by last year's profits, is somewhat thin. The annual meeting is to be held on November 2nd, and a shareholder, Mr. J. E. Elwyn Jones, has notified his intention of proposing a revision of the Trust's capital structure. This the same gentleman has done on two previous occasions, the proposal being defeated each time. There would seem to be no greater necessity at the present time for a change to be made than there was when the earlier proposals were put forward.

Calcutta Trams

The directors of the Calcutta Tramways Company prudently hesitate to express any view as to the price which the company will be paid by the Calcutta Corporation when the latter takes over the tramway undertaking next January. The chairman said at the meeting last week that the purchase money cannot be ascertained until the current year's results are known, because the price will be based on figures of income and working expenses over a period of years. It appears that the Calcutta Corporation's contract refers only to a part of the Calcutta Tramways undertaking, and that a portion of the system lies outside the agreement. Presumably the whole of the system necessary for the Calcutta Corporation to acquire control of the tramways will be included in the transaction. The shares have dropped back to 65s. 6d. at the prospect of the sale negotiations being delayed by possible need of legislation to confirm them.

Isle of Thanet

The interesting part about the offer of Margate and Birchington to purchase the undertaking of the Isle of Thanet Electric Supply Company is, in the first place, whether the Electricity Commissioners will approve the transfer, and, in the second, provided they give their consent, at what price the preference shares will be paid off. The basis of purchase is known already, but whether the preference holders will receive more than the par value, 20s., for the shares is a matter for doubt. Curiously enough, no provision was made in the original articles for this contingency, and it remains to be seen whether the preference are paid out at a higher price than 20s. if the sale goes through. The question of principle involved is one of importance to many companies.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

AUTOMATIC Telephone & Electric Co., Ltd., and E. E. Comfort.—"Automatic switches as used in telephone or like systems." 4688. March 23rd, 1943. (564431.)

A. F. Bound and A. Rankin.—"Electricity generating plant, particularly adapted for use in train control systems." 4612. March 22nd, 1943. (564429.)

British Insulated Cables, Ltd., and W. C. Handley.—"Terminal arrangement for electric condensers." 9046. June 5th, 1943. (564455.)

British Insulated Cables, Ltd., London Passenger Transport Board, J. Holland and H. J. Powell.—"Tool for straightening or bending metal wire, tube, bar and the like." 7079. May 5th, 1943. (564401.)

British Thomson-Houston Co., Ltd.—"Dish-washing apparatus." 10751/43. July 3rd, 1942. (564470.) "Terminal structures for electric lamps." 5474/43. April 9th, 1942. (564493.) "Gas turbine power plants." 10672/43. July 1st, 1942. (564498.) "Electron-discharge circuits." 11151/43. July 11th, 1942. (564504.) "Switching mechanism particularly suitable for electric discharge lamps." 11775/43. July 21st, 1942. (564531.)

British Thomson-Houston Co., Ltd. (General Electric Co.).—"Electric valve converting apparatus." 4773. March 24th, 1943. (564396.)

E. G. Budd Manufacturing Co.—"Protective systems for electrical apparatus." 10702/43. July 4th, 1942. (564469.)

Chamberlain & Hookham, Ltd., S. James, E. A. Webb and W. F. Braines.—"Totalising means for use with a group of electricity meters or other electrical instruments." 8411. May 26th, 1943. (564453.)

E. K. Cole, Ltd., and J. N. I. Evans.—"Fluorescent low-pressure mercury vapour electric discharge lamps." 7227. May 7th, 1943. (564449.)

E. S. Conradi.—"Electric coupling devices, particularly of the plug-and-socket type, and anchoring means therefor." 621. January 13th, 1943. (564419.)

L. P. C. J. Dudley and R. L. Mansi.—"Methods of and means for making stereoscopic X-ray photographs." 4908. March 26th, 1943. (564490.)

J. Forman and Pye, Ltd.—"Radio range-finders and altimeters." 3045. March 6th, 1941. (564505.)

Frigidaire, Ltd., and F. A. S. Abbott.—"Household refrigerator." 6480. April 22nd, 1943. (564398.)

Frigidaire, Ltd., W. B. Daniels and F. A. S. Abbott.—"Refrigerator." 4729. March 23rd, 1943. (564433.)

General Electric Co., Ltd., and H. C. E. Jacoby.—"Electric suction cleaners." 9347. June 10th, 1943. (564459.)

P. S. Harper and Harper Automatic Machine Manufacturing Co., Ltd.—"Coin-operated electric switch." 15937. November 11th, 1942. (564479.)

S. I. Hitchcock.—"Permanent magnets." 18278. December 23rd, 1942. (564508.)

S. R. R. Kharbanda and Pye, Ltd.—"Combined television and sound systems." 320. January 7th, 1943. (564511.)

Landis & Gyr Soc. Anon.—"Maximum-demand measuring device." 17742/42. December 15th, 1941. (564482.)

J. Lucas, Ltd., and H. E. Whitehouse.—"Flywheel magnetos." 4601. March 22nd, 1943. (564428.)

Marconi's Wireless Telegraph Co., Ltd., and E. Green.—"Radio beacons." 4866. March 25th, 1943. (564445.)

Marconi's Wireless Telegraph Co., Ltd., and G. I. Hitchcox.—"Automatic gain control systems for radio receivers." 4865. March 25th, 1943. (564444.)

Morris Motors, Ltd., R. J. Brown and J. H. Bridle.—"Electromagnetic apparatus for use in the examination of ferrous articles." 8049. May 20th, 1943. (564451.)

Mullard Radio Valve Co., Ltd., R. G. Clark and L. M. Myers.—"Electron-discharge tubes." 11689. August 19th, 1942. (564441.)

J. F. O'Brien.—"Operating means for electric switches." 4925/43. March 26th, 1942. Addition to 544435. (564491.)

Philco Radio & Television Corporation.—"Cathode-ray television tube." 4414/43. March 30th. 1942. (564425.)

Radio Corporation of America.—"Current control systems." 4497/43. March 24th, 1942. (564427.)

A. I. Rochmann.—"Electrically heated soldering irons." 461. January 9th. 1943. (564388.)

Standard Telephones & Cables, Ltd.—"Method of reclaiming selenium elements of the electric current rectifier type." 10277/43. June 27th, 1942. (564464.)

W. E. Stilwell, jnr.—"Overhead protective electromagnetic switch." 4845/43. March 12th, 1942. (564443.)

W. W. Triggs (Akt.-Ges. Brown, Boveri & Cie).—"Apparatus for the transmission of messages." 9880/41. April 13th, 1943. Convention date not granted. (564475.)

W. W. Triggs (Philips-Lampen Akt.-Ges).—"Electrical remote control." 8059. June 12th, 1942. (564410.)

United States Rubber Co.—"Insulated electrical conductors and method of making the same." 10762/43. August 5th, 1942. (564471.)

Western Electric Co., Inc.—"Electron-discharge devices." 6390/43. April 21st, 1942. (564494.)

Westinghouse Electric International Co.—"Electrical measuring systems for X-ray apparatus." 10903/43. July 4th, 1942. (564500.) "Method of producing corrosion-resistant phosphate coatings on metal and alloy metal surfaces." 3661/43. March 6th, 1942. (564521.) "Method of producing compositions for activating metal and alloy surfaces to improve the process of forming corrosion-resistant phosphate coatings thereon." 3662/43. March 6th, 1942. (564522.) "Electric current conversion systems." 11620/43. August 8th, 1942. (564530.)

H. Ziebolz.—"Electronic translating devices." 16478/42. April 22nd, 1942. (564382.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—NEW SOUTH WALES.—November 2nd. Sydney County Council Electricity Undertaking. L.v. feeder voltage regulating transformer. Spec. 717.

QUEENSLAND.—November 15th. Motor-driven and turbine-driven boiler feed pumps. Spec. 375. City Electric Light Co. Ltd., Boundary Street, Brisbane.

Lanark.—County Council. Various works, including electric lighting, in eight houses; S. McColl, county housing architect and engineer, 29, Clydesdale Street, Hamilton.

Manchester.—October 23rd. Electricity Dept. Water cooling tower, mercury arc rectifier equipment, and traction switchgear. (October 13th.)

Montgomeryshire.—October 23rd. Education Committee. Electric lighting installation, etc., Bryn Street Centre, Newtown. Director of Education, County Education Offices, Newtown.

Portsmouth.—October 23rd. Electricity Department. 33-kV underground cable. (October 13th.)

Orders Placed

Blackburn.—Corporation. Accepted. Electric motor and switchgear at Blackburn Sewage Works.—C. T. Briscoe & Son.

Hull.—Electricity Committee. Accepted. Ash-handling plant (£8,225).—John Thompson (Wolverhampton). Water softening plant (£709).—Permutit. Civil engineering works at Sculcoates power station (£37,698). Quibell & Son. High-pressure water fire-extinguishing equipment (£3,059).—Mather & Platt.

Newcastle-on-Tyne.—City Council. Accepted. Electrical repairs to Council houses (£160).—R. H. Patterson.

Salford. — Electricity Committee. 125-kW mercury-arc rectifier (£791).—Metropolitan-Vickers.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Anglesey.—Intermediate school, Amlwch, for E. C.; J. E. Rees, county education architect, Glanaber, Llangefni, Anglesey.

Chesterfield.—Works additions, Sheffield Road; Brocklehurst Motors, Ltd.

Ealing.—Additions and alterations, Uxbridge Road, for V.A.B. Products, Ltd.; W. H. Read & Co., architects, Haven Green, W.5.

Frodsham.—Extensions to homes; superintendent National Children's Home and Orphanage, Beaconshurst, Netherton, Frodsham, via Warrington.

Hebburn-on-Tyne.—Canteen for the Bushing Co., Ltd.; Alex. Anderson, Ltd., Stanmore Road, Newcastle.

Office extensions for A. Reyrolle & Co., Ltd.; Alex. Anderson, Ltd., Stanmore Road, Newcastle.

Jarrow-on-Tyne.—Factory, for the Jarrow Boiler & Welding Co., Ltd.; G. W. Smith, Wansbeck Road.

Manchester.—Tuberculosis sanatorium, Wythenshawe; G. Noel Hill, city architect, Town Hall, Albert Square.

Moston.—Moulding shop and kiln bay at works, St. Mary's Road; W. Thorpe & Son, Ltd., Chester Road, Cornbrook, Manchester, 16.

Newbiggin (Northumberland).—Houses (10) for Northumberland Aged Miners' Homes Association; W. Dixon & Son, architects, Collingwood Street, Newcastle.

Newcastle-under-Lyme. — Dairy, Hempstalls Lane, for Associated Dairymen (Staffs.) Ltd.; Adams & Edwards, architects, 3, Brook Street, Stoke-on-Trent.

New school for managers of St. Giles' and St. George's School; Rev. C. J. Watkins, Seabridge Road.

Newcastle-on-Tyne.—Reinstatement of Muscott Grove School; city estate and property surveyor, Town Hall.

Northumberland.—School kitchens: Bamburgh C.E.; T. Gardner, Berwick. Beadnell C.E.; T. B. Gregory, Seahouses. Carham Wark; Patterson Bros., Branxton. Seghill Infants'; J. M. Reid, Seaton Delaval. Slaley Council; M. Hogarth & Son, Corbridge. Newton-on-the-Moor Council; J. G. Green & Son, Warkworth.

Oxford.—Houses (10) Quarry High Street, Beaumont Road and Purcell Road; J. A. Pye, Ltd., builders.

Rowley Regis.—Rebuilding ten houses; City Road, Tividale; borough engineer, Municipal Buildings, Old Hill, Staffs.

Sheffield.—New church and parsonage (£18,000); Rev. P. Tuckwell, St. Cyprian's, Frecheville, Sheffield.

Sunderland.—Alterations, Hendon Road, for St. John's Maltings, Ltd.; Page, Son & Bradbury, architects, King Street, South Shields.

Swindon.—Waterworks (£17,500); borough engineer.

Tynemouth.—Premises, new trading estate; Flemings, cleaners, Newcastle; De La Rue Plastics, Ltd.; Linklaters, patent ship fittings; North Shields Co-operative Society bakery; Charles Clay & Co., clothing manufacturers; Knitwear, woollen goods manufacturers; Welch & Sons, Ltd., confectionery manufacturers.

Warrington.—Additions to tannery; Union Tanneries, Ltd., Holmefield Tannery.

Two secondary schools; J. Y. Hughes, borough surveyor, Municipal Buildings, Bank Park.

Wellington.—Ambulance station, Donnington, for R.D.C.; J. B. Cooper, architect, 177, Corporation Street, Birmingham.